THE ROLE OF CHILDREN'S RACIAL IDENTITY AND ITS IMPACT ON THEIR SCIENCE EDUCATION

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ABSTRACT

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Racial identity plays an important role in the development of children's narratives. In the structure of the classroom there is a disconnect for students between home and school. The structure of the classroom consists of the social relationships that children have with their peers and teachers. The structure of the classroom also includes how the classroom is set up for learning, such as the curriculum. Racial identity is also a valuable aspect in the construction of knowledge as children learn science. Racial identity is not often addressed with young children and science. Young children need to be able to see themselves in science regardless of their own race or ethnicity. Critical race theory (CRT) was used to examine and situate the context of race with children's identity. Sociocultural theory was used to describe their process of learning. The participants of this study included 10 children in grades 3 through 5 who attended a diverse urban school located in New York City and their parents (10 parents). A qualitative approach was used to allow both children and parents to share their perspectives on their experience with science and difficult topics that pertain to race and/or skin color. The research designed was mixed methodologies to draw from narrative inquiry and then quantitative methods were used in the design of the Likert-surveys. Qualitative findings address the

intersections of race, community, and school for elementary children as they navigate their racial and science identities. The context of race and racial identity was apparent for all 10 participants. Each participant had experience with the social context of race and had expressed feelings about race through dialogue at home and/or at school. This indicates that the role of family socialization regarding conversations about race and skin tone influences children. By examining the racial identity development of children, this study provides science educators with perspectives on how to gauge students' learning of science and their accessibility to science. The conceptualizations of scientist varied based on the children's experiences and stereotypical images of science. Overall the findings indicate how family and school are situated in one's community of practice. The influences of both family and school contribute to one's identity and how they see the world from a racially and scientifically. Notions of race and science were not dependent on each other. The next steps include examining more in-depth racial socialization of families, the positionality of teachers, and the role of school-university partnerships in science identity development.

DEDICATION

To my grandmother, for the long days and nights in taking care of me. I am so blessed to have a grandmother like you, forever selfless and dedicated. This degree is for your love and passion as you guided me to the best person I can be. When I felt as if the world had left me, you wrapped your arms around me and told me I would be okay. You would always say the Lord would never leave me or forsake me and that I can do all things through Christ which would strengthen me. You too have done the same. Even though you are not here with us, I can feel you at every beat. We did it, Grandma!

To my beautiful daughter, Ava-Kai your enjoyment for life, others, and science is a true testament as to why I have done this work. Your curiosity about the world is contagious and how you see the world. Continue to shine your light. I love you with all my heart. Thank you for taking care of me along this journey. You have attended the majority of my classes with me, been present at presentations, came to each of my studies and sat in the hall, and you have held my hand each step.

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When we first met, I was just a pre-service teacher and 7 months pregnant. You sparked something inside of me; you inspired me to be the best educator I can be. I can still hear the questions you posed on our first meeting that hot summer day in May 2011: “How are you going to teach science to kids in urban environments like NYC?” “How are you going to incorporate social justice teaching in all that you do to promote critical literacy?” Well Dr. Mensah, I have been doing it because of your passion for science education. I am so proud of you and am blessed to have you in our lives. Keep pushing me!

I also thank Jennifer Kaiser for giving me agency and helping me find my voice without your guidance I would not be the teacher I am today. It is your class where I taught my first science lesson and embraced my calling. I also thank you for being there for me and my daughter. You are her second mother.

To the students and families who have participated, thank you for allowing me to share your voice and give insight to the field of science education.

To every educator, student, and their families who have helped me along this journey. -LMM

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Chapter I

INTRODUCTION

The objective of this study is to understand the social context of race in elementary students' identity development as learners. In the context of schooling, children's construction of their own racial identity is not often considered as impacting students' access to learning science. Students' racial identity development needs to be taken into consideration due to the structure of our American education system such as the role of curriculum and the everyday classroom structure. Therefore, there are many terms used in defining racial identity. For the purposes of this study, Weijeyesinghe's (2012) definition of racial identity is used. Weijeyesinghe defines racial identity as

> the racial category or categories that an individual use to name him or herself and these are based on factors including racial ethnicity, physical appearance, early socialization, recent or past personal experiences, and a sense of shared experience with members of a particular group. (p. 82)

Critically examining the racial identity development of young children provides science educators with the perspective on how to gauge students' learning with scientific concepts and their experiences from home. For example, when teaching a lesson, educators could benefit from asking students about their prior knowledge of a particular concept such as the needs of plants to help bridge in the science concept of plant biodiversity that children need to learn about.

Another objective of this study is to understand students' access to science education within their schooling experiences and if this has helped shaped their science identity. Incorporating children's racial identity can create equitable science learning opportunities and engagement in science (Lee & Buxton, 2011). Theories of sociocultural theory and critical race theory are used to examine the complex relationship of students' identity, learning, and social environment. Sociocultural theory acknowledges that learning is based on one's personal experiences and how these experiences shaped one's perspectives (Lave & Wegner, 1991). Critical race theory acknowledges race as missing in the dialogue of race, society, and power (Ladson-Billings & Tate, 1995).

My Positionality

I am a Black, female, elementary teacher, and I came to focus on the role of children's racial identities in their science education based on my own educational experiences. Examining my identity and positionality within education is very emotional to me because I have always had to navigate my racial identity as a learner and as a teacher. I was often the only child of color in the classroom from middle to high school. The role of science was consistently present due to the classes I had to take, but I never felt like science had a place for me. When I entered my pre-service education program, I was one of four women of color in my cohort and had minimal teaching experience as a career switcher from a community mental health case manager to education.

Another phase in my life, I was faced to examine my own racial identity, and it made me feel inadequate. I had the feeling that teaching had no place for me and yet again I felt inadequate for being Black. I remember being placed with a mentor teacher, and she wanted me to follow lessons from a book which were scripted from the

beginning to the end. From our year together, I had no voice. Sounding like myself was not good enough which was odd to me because I thought my colloquialisms were fine. I am well versed in code-switching, moving from academic language to everyday speech and phrasings. These experiences from my pre-service program made me question if I should refer to myself as a Black teacher. Early on in my teaching career, I did not refer to my racial identity. I did this because I was afraid and aware of negative images often placed on Black female teachers. In my mind, I wanted to be different from the stereotypes, and I wanted people to see me differently. As I reflected, I felt teachers and others I have taught knew saw me differently. My colleagues and students seen me as a teacher who was caring, thoughtful, and wanted to create engaged learning opportunities for all students.

As an elementary school teacher, I often asked myself if students and students of color had similar experiences in their own understanding of their identity development. Early on as a young study, I was made aware of racial differences and how those differences set you apart from achieving success depending on your academic setting. My experience from elementary school to graduate school resonated with me because of the work I was doing with children.

Due to my own experiences inside and outside the classroom, I wanted to learn more about children's racial identities and what impact racial identity has on children and their education. While being a pre-service teacher, my course work was impactful in how I viewed children from a holistic lens, but it left me color blind (Milner, 2005; Milner & Laugher, 2015). Being color blind is when teachers do not address race and see race as

neutral, such as referring to students and their ethnicities as a large melting pot, instead of addressing each student as an individual with their own racial identity.

Due to my lack of awareness of addressing race in the classroom, I was unaware of the inequities that education had for marginalized children or how science education was taught. The majority of my teaching career was taught at charter and public schools which identified as Title 1 schools. Which means that more than 50% of the student body receives free or reduced lunch. A title 1 school also indicates the lack of resources at the school as well. In comparison to where I currently teach, my current school is a private school, resources for students and teachers are abundant. Teachers have access to materials and have spaces to teach science instead of purchasing their own materials to deliver a lesson. In my previous schools, teaching science was not always seen as priority due to the Common Core Learning Standards. The concepts of racial identity were not part of the discussion in my classroom or fellow colleagues. Due to this lack of discussion at my schools, I didn't discuss racial identity within my own classroom setting. In many ways I thought I had addressed it, but I often had a color-blind approach in how I taught my students. Perhaps I downplayed their racial differences and their own identity development. Which lead me to focus on the role of children's racial identities in their science education.

I choose to focus on the role of children's racial identities in their science education and readiness for instruction after I took an elementary science education course in my graduate program. During this course, I learned how to make science more accessible to marginalized students by using their urban environment as a way to foster their interest in scientific learning. From the class, I learned that many students did not

see themselves as scientists. Their insight allowed me to grapple with my own identity and relationship with science education. Similar to the students that I was teaching, I never identified as a scientist, science student or a science teacher. When I was in elementary school, science was not taught. Therefore, I did not have my first experience in learning science until middle school. I remember the disconnect I felt to the content and to myself as a learner.

Through my coursework and teaching experience, I have witnessed how providing access to science prepares students for success and empowers them with the tools they need to be active citizens in our society (Guzey, Harwell, Moreno, Peralta, & Moore, 2016). As I learned more about science education, I grappled with what I could do to change the perception of science for my students and for myself. I began to consider how I could demonstrate the idea that science is all around us and that we could all be scientists, even in urban settings. To do this type of work, I created a lesson that integrated literacy and science for a nutrition lesson for my final assignment for my graduate course in elementary science methods.

As I constructed this lesson, I realized that I could incorporate the identity of science into my teacher identity. Since delivering the lesson, I have put science education at the forefront of my work as an educator, and I incorporate science into all of my teaching. I am consistently impressed by the engagement and eagerness my students show when I manifest my joy for science. As teachers, we fail to realize that our attitude toward particular subjects often resonates with our students. Had I not exhibited my joy for teaching and learning science, then my students' interest in science would reflect how I felt (Mensah, 2011).

As I continue to gain more education and teaching experiences, I am constantly reflecting on my experiences and how I position myself amongst different social markers, such as race, gender, and religion. These top three social markers guide my pedagogical practice (Mensah, 2011, 2016; Moore, 2008). Additionally, identifying the different social markers that have guided my educational and teaching experience continuously leads me to be quite vulnerable because I do not like to address the inequities; it can be painful for me because this is how my own experiences were in education as a child. As an adult, the conversations of inequities within education make me feel as if I am the only person sometimes who views education from multiple perspectives. However, I know that I need to continuously share my narrative and the progress that I have made to those who become teachers in our education system.

The educational system challenges teachers to address many things such as content learning and social-emotional learning. Geelan, Mensah, Rahm, and Maulucci (2010) ask, "Do teacher candidates know what they are getting themselves into when they say they want to be teachers?" (p. 650). As a previous teacher candidate, I did not know. I initially went into teaching to help students stay out "the system" because I saw the crippling effects of an educational system while working in community mental health.

Almost 10 years later, I have not quit teaching because it is fulfilling work, and teaching science in urban elementary schools needs to be a priority because it allows students to truly see the world around them, especially the communities they live in from a scientific lens. However, as a teacher, the faint-hearted will not be able to stand or swim; teaching is professional work, and teachers need encouragement and support to learn and grow as professionals (Geelan et al., 2010). With remarkable mentorship, being

in the teaching profession has helped shaped me into a better educator and parent. I know the inequities will not stop, but I am optimistic that educators can change the role of education one step at a time.

When you are a pre-service teacher and novice teacher, you are constantly asked to reflect on your lessons and to think about next steps, but rarely are teachers asked to reflect on their own identities or how their identities have shaped their pedagogy. Mensah (2016) ask teachers, "How does your background/identity influence your views of teaching science and teaching diverse students? And select your top three social markers" (p. 54). When initially doing this positionality activity, I chose to focus on socioeconomic status, class, and education as my top three social markers. Then I replaced my top social marker race with socioeconomic status because of my relationship and coming to understand the influence of race more in my education. I have done this Card Sort activity (Mensah, 2012, 2016) several times since then, and it is interesting to see how race comes in and out of my top three social markers. I think this is because race has been crippling for me, yet it has shown me how resilient I can be. Within this past year of doing this activity, I have added gender and religion as part of my top three social markers.

The selection of these social markers allows me to explore and question how students can access science learning to their perceptions and experience in the context of their schooling of who people are as scientists and learners. In doing this positionality activity with White colleagues, it is interesting to see how race has never played a part of one's identity. It is also interesting to learn that they have not been asked to think about their identity in this way.

Without challenging my assumptions and understanding my own experiences in science education, I would not be able to address Kohli's (2012) questions:

> How can teachers of color facilitate cross-racial understanding and unity among students without having cross-racial understandings of themselves? How can teachers of color challenge racial oppression if they do not recognize racism as a systemic problem that impacts all people of color? (p. 181)

For both of Kohli's questions, addressing the relationship of race, power, and education is difficult. Even I thought it would go away because of my teaching and educational experiences. As an educator of color, it is at the forefront in all that I do. I must say, for every time I have to address race in education, I am always thinking about how to address these understandings. As such as, thinking about my voice, tone, and facial expressions because these are unfair stereotypes that are still plagued by Black women. However, looking at my experiences from this critical lens provides deep insight into the narratives that are faced by teachers of color (Geelan et al., 2010; Mensah, 2018). As I understand myself better, I strive to help children see themselves better also because children should be able to see themselves inside the classroom—and the science classroom—and not feel disconnected.

Cross-Racial Understandings of Children

For many marginalized children, there is a disconnect between home and school connections with science (Basu & Barton, 2005). Due to this, teachers fail to realize that the structures of race and diversity are valuable frameworks in examining the construction of knowledge in urban science education classrooms (Gunning & Mensah, 2010; Moore, 2007). By studying the identity development of young children, we can see their individualistic and sociocultural views (Brown, Reveles, & Kelly, 2005). However,

in addressing identity development among children within the context of science, the literature tends to focus on adolescents and young adults (Moje, Pappas, Tucker-Raymond & Varelas, 2007; Mutegi, 2011; Parsons & Carlone, 2013). Also, theories of identity have not been prominent in the discussion of scientific literacy (Brown et al., 2005). This study aims to bridge that gap by discussing theories of identity for children within scientific literacy using Dewey's (1902) framework of seeing students as explorers.

It has been helpful for me to use Dewey's (1902) conceptualization of students as being explorers on a journey; their learning experiences construct their understandings about their identities. Examining racial identity as part of a child's "map" for "exploration" (Dewey, 1902) allows us to see how children navigate their experiences with home, race, schooling, play, community, and friendships. This also suggests that "the map orders individual experiences, connecting them irrespective of the local and temporal circumstances and accidents of their original discovery" (p.198). In further understanding children's experiences of their world, racial identity also plays a role in the development of children's narratives (Leonardo & Grubb, 2012).

Identities are shaped by "social structure that is formed among a learner, other members of the social structure and the nature of the activity in that structure, influence participation, knowledge development, emotions, and actions foster the growth of relationships" (Varelas, 2012, p. 4). When we critically examine identity from this lens, we can see the interconnections and influences of one's identity. The interconnections of one's identity provide us with a multimodal narrative to understand how one's experience is shaped (Moje, Pappas, Tucker-Raymond & Varelas, 2007).

Early on as a classroom teacher, I only examined children's identities through their learning styles. I was not made aware of how their identities are also contributing to their communities of practice as well. I think for many teachers we forget this aspect of learning for the children we teach because of assumptions we have about the communities they live in. Also, many times we are teaching in schools where we think children's socioeconomic status, gender, parents education background, or racial/ethnic differences will not be a problem, but that is not the case at all. In every school I have taught in-- charter, public, and private-- where our children come from matters. Children need to feel successful and see themselves as part of the disciplines that we are teaching them, such as science and mathematics.

As educators, our goal is to foster a community that encourages students to make sense of and validate their existing knowledge rather than attempt to fit their knowledge about the natural world into a pre-existing curriculum (Driver, Asoko, Leach, Mortimer, & Scott 1994; Kane, Varelas, &Wylie, 2012). When we allow students to bring in their funds of knowledge to the classroom, it makes learning more meaningful and concrete. Basu and Barton (2005) suggest that educators use students' existing funds of knowledge to give them agency with science because it helps foster the connection of home and a social life that students bring with them every day. We assume that young children's experiences are limited because of their age. However, they have experienced more than what we give them credit for.

Purpose of the Study

The purpose of this qualitative study is to (a) understand children's perspectives about racial identity development, (b) examine the learning of science that takes place in

the children's schools, and (c) explore the role of family socialization regarding their child's learning and their notions of science. In exploring both children's racial identity and science identity, a key paradigm to this relationship is parent and family engagement with the child's schooling in grades 3 through grade 5.

This study offers insights into children's ideas and thoughts from their voice in how they see the world and science around them. For this study, the term *urban* is used to define the school as an "institution in a metropolitan center with a common cultural demographic characteristic" (Brown, Mangram, Sun, Cross, & Raab, 2016, p.176). The decision to do this study in a school located in an urban environment is because research on science education, race, and identity challenge teachers to recognize the modalities of race and culture in addition to developing successful and effective learning practices (Brown et al., 2016).

Research Questions

Based on my experiences as a teacher and my curiosities about the role race places in the lives of young people, the research questions for this dissertation study are:

1. How does the role of racial identity development influence children's approach to learning science?
    a. In what ways does racial identity development encourage or discourage students access to learning science?
2. What role does family socialization have in how their child's racial identity development and science identity development?

Organization of the Chapters

In Chapter I, there is an introduction addressing the need and purpose of the study due to examining how theories of identity impact students' science educational experiences. It also includes a section on the researcher's positionality and experiences with critical theory as she examines the role of race within education. These experiences have been interconnected in her life as a student, pre-service teacher, and novice teacher. These experiences have been explored to illustrate how teachers need to challenge their assumptions from their lived experiences to teach diverse children about encompassing race and science within their curriculum (Basu & Barton, 2005; Mensah, 2016; Moje et al., 2007).

Chapter II gives a literature review on the importance of race and racial identity development within the context of science education. With the understanding racial identity of young people in science, there is also an important aspect to consider-- parent engagement, and how young students' identity is shaped or influenced by their parents. Chapter III describes the methodology of how the study. It includes the setting, the participants, data collection methods, and analysis techniques. The findings are documented in Chapter IV and Chapter V. Finally, Chapter VI provides Discussions of major findings, along with the Conclusion and Implications for further studies.

Chapter II

LITERATURE REVIEW

The literature review chapter begins with the importance of race in education. In this section, a historical context of race and the definition of race give insight as to how race was developed as a social construct to distinguish differences. A historical context of race is provided to illustrate how race has merely been used as a physical marker to determine various aspects of one's abilities or lack thereof. The social construct of race is also used to examine the culture of power that race impacts for students from diverse backgrounds. This role of power is also used to discuss science education in terms of giving students access and agency within science. The notion of discourse is examined to help illustrate the context of the discomfort and the importance of racial dialogue in classrooms. The role of discourse examines how children in science education are situated in urban settings.

In the second part of the chapter, I discuss theories of identity in science education and specifically a Racial Identity Development framework using Wijeyesinghe's (2012) Racial Identity Development. This framework is used to examine how racial identity is used in how one identifies themselves and how young children understand race based on physical appearances such as skin color or food (Rowley, Burchinal, Roberts, & Zeisel, 2008). Also, critical race theory (Ladson-Billings & Tate, 1995) and sociocultural theory (Lave & Wegner, 1991) are also used as the theoretical frameworks of this study. The particular frameworks were chosen for study because they

both offer different perspectives of learning environments. Both frameworks also provide implications for culturally relevant and responsive teaching The purpose of this literature review is to give insight as to why this type of research is important in studying theories of identity with young children in science education.

Achievement Gaps in Science Education

Large achievement gaps in science continuously affect students in grades 3 through 8 (Morgan, Farkas, Hillemeier, & Maczuga, 2016; Quinn & Cooc, 2015). These gaps exist between Black (students identifying as being African American or African descent) and Brown (students identifying as Caribbean or Latin X descent) students and their white counterparts; therefore, science education research has to be aimed at improving students' science learning and experiences (Walls, 2016). The gaps in science achievement also illustrate an underlying problem of inequities within our education system, access to school curriculum and science, and funding (Ladson-Billings, 2006; Quinn & Cooc, 2015).

However, these inequities provide further insight into the disconnect between home and school to science for many marginalized students (Basu & Barton, 2005; Lee & Buxton, 2011). For example, the discourse that is used at home in addressing concepts or lack thereof in regard to science could impact a student's ability to relate to the concepts in the classroom. To better support students and the disconnect of science within their community of practice of home and school, opportunities to bridge the gap for students, their identity, and communities of practice need to be taken into consideration.

Racial Identity

Byrd (2012) outlines "awareness, identification, and attitudes" as imperative in children developing a racial identity (p. 4). Byrd defines "awareness" as being able to distinguish racial differences, "identification" as naming one's race correctly, and "attitudes" as perceptions of characteristics of different racial groups (p. 4). This notion of awareness is developed and acquired through education. Education is often the first place where children get the opportunity to examine themselves and how the world works. According to Baldwin (1963),

> The paradox of education is precisely this-that as one begins to become conscious one begins to examine the society in which he is being educated. The purpose of education, finally, is to create in a person the ability to look at the world for himself, to make his own decisions, to say to himself this is black or this is white, to decide for himself is whether there is a G-d in heaven or not. To ask questions of the universe and then learn to live with those questions, is the way he achieves his own identity. (p. 287)

The context in which Baldwin wrote this and its relation to the role of education continues to exist for us today in the field of education. It also illustrates how imperative it is for us to help the children we teach to tap into their identity development and to help them make sense of the world around them as they construct themselves as young scientists.

In understanding and defining racial identity among children, it is important to examine the historical context of the ideology of race in American history. In the 17th century, race was a term used to refer to populations that interacted with North America, such as Europeans, Africans, and Native Americans (Smedley & Smedley, 2005). As colonialism settled in the 18th century, race was used to define human differences (Smedley & Smedley, 2005). The association of race as differences leads to defining race

as a social construction. Renn (2012) defines race as a "social construction based on physical appearances, ancestry, nationality, and culture" (p. 11).

Race can also be defined as an "intersection of other forms of oppression such as class, gender, religion, phenotype, and nationality" (Akom, 2008, p. 257). Studying children's racial identity helps us put in perspective the role of intersection, that of race, power, and agency in the classroom (Johnson, 2012). It also helps us to understand the power dynamics and culture of power within the classroom as well (Delpit, 2006).

In examining the intersections of power and race within the classroom, Delpit (2006, p. 24) defines this notion of power within the classroom as the "culture of power." She describes it as follows:

- Issues of power enacted in the classrooms.
- There are codes or rules for participating in power.
- The rules of the culture of power are a reflection of the rules of the culture of those who have power.
- If you are not already a participant in the culture of power, being told explicitly the rules of that culture makes acquiring power easier
- Those with power are frequently least aware of or least willing to acknowledge its existence.

The first tenet of the culture of power addresses the power of the teacher over the students; the power of the publishers of textbooks and the developers of the curriculum to determine the view of the world presented; the power of an individual or group to determine another's intelligence or normalcy… then schooling is related to that power (Delpit, 2006). This first tenet of the culture of power concept illustrates how the notion

of power can hinder one's learning experience solely based on the classroom environment. It is important to examine and reflect on this fact because children have different perspectives and learning styles based on their awareness.

As we think about children's differing forms of awareness, we must also think about how their voices can be heard and their questions addressed, and whether their voices are silenced. Delpit (2006) suggests that,

> . . . listening that requires not only open eyes and ears but open hearts and minds… To put our beliefs on hold is to cease to exist as ourselves for a moment and that is not easy… because it means turning yourself inside out, giving up your sense of who you are and being willing to see yourself in the unflattering light of another's gaze. (pp. 46-47)

This quote resonates with me continuously because as a Black educator I want to step inside my children's shoes and see life from their eyes. At times, I am successful and at other times I need to listen more because it is not about me. It is about the children I teach. If we do not examine race, identity, or the culture of power then "understanding identity becomes separated from sociocultural, socio-historical, sociopolitical dimensions of who a person is and how a person chooses to define self" (Mensah, 2016, p. 106).

The Discourse of Race in the Classroom

Discussing race in a classroom setting is difficult for teachers including me because race is complex, but it impacts everyone whether they are aware or not (Coles-Ritche & Smith, 2017; Mensah, 2018; Milner & Laughter, 2014). When discussing race in the classroom, teachers adopt colorblind ideologies and positions. This influences teachers in having a neutral mindset in how they see race. (Milner, 2005, 2014; Walls, 2016). As a classroom teacher, I remember doing this as well because I wanted students to see how I was just like them and we are just like each other.

Milner (2014, pp. 343-344) suggests mindsets that are common among colorblind teachers, or when teachers do not address race in their classrooms:

Mindset 1: If I acknowledge the racial background of my students or myself, then I may be considered a racist.

Mindset 2: I treat all my students the same regardless of their racial or ethnic backgrounds.

Mindset 3: I focus on teaching children and ignore the race of my students because race is irrelevant.

Mindset 4: Race does not matter in my teaching because racism has ended.

Mindset 5: We live in a post-racial society and my classroom practices are, will be, and should be post-racial.

These mindset positions are problematic on several systemic levels. For example, in examining these positions, we see how difficult it is to recognize the power structures that exist within race on an institutional level, a systemic level, and at the classroom level of teacher practices (Milner & Laughter, 2014). As we think about who students are, they are all different and their differences should be embraced. However, by ignoring students' differences, including their race, it is a disservice to their racial identity, their realities of how they see the world, and how they see themselves (Milner & Laughter, 2014). Also, by ignoring students' differences we continue to play a role in institutional and systemic classroom practices that hinder students' learning (Milner & Laughter, 2014).

I do want to note that being colorblind and having a colorblind mindset is not based on a teacher's race or ethnicity. As a Black teacher, I was colorblind as well. I, too,

was guilty of creating a post-racial environment in my classroom, until my students addressed their feelings about race in their communities after the death of Eric Gardner (http://www.msnbc.com/msnbc/what-killed-eric-garner). Indeed, Milner and Laughter (2014) suggested that "educators can use conversations about race as powerful tools for engaging promptly in the analysis of the ways students experience school and classrooms" (p. 173). From my own classroom experience, many children have experienced race as early as kindergarten in social settings such as the classroom learning time, cafeteria, or the playground.

In elementary classrooms, Coles-Ritche and Smith (2017) suggest the discussion of race is often avoided. This impacts everyone as there is still a significant achievement gap amongst minority students in comparison to their white counterparts (Curan & Kellogg, 2016; Picower, 2009). There are a variety of issues that stem from the lack of discussion of race in the classrooms in elementary school such as the demographics of teachers in urban schools being majority white female teachers (Picower, 2009). This demographic challenge us to look at whiteness in teaching in the classroom. We have to examine the role white teachers play in our students of color and their success in terms of racial achievement and opportunity (Picower, 2009).

In discussing race, many white teachers are unaware of their own racial identity which blinds them from their privilege. This unawareness then, in turn, maintains a white supremacy notion which doesn't allow our students from diverse backgrounds to succeed. Our students of diverse backgrounds are not able to succeed because of teachers not examining the culture of power to help students succeed. Picower (2009) suggests that white teachers develop an awareness and or/critical consciousness that allows them to

address race, privilege, and oppression. Instead of white teachers having a hegemonic fear that they too are victims, because this is not the case, our students from diverse backgrounds do not have their privilege. To provide our students with access to a culture of power, we need to examine our privilege.

In our education system the answer that has been used to challenge whiteness in teaching is to bring in more teachers of color. However, teachers of color can also have white supremacy ideologies within their practice. What our teaching education force needs are teachers of color who are committed to equity and social justice in urban education (Picower, 2009). Our teaching force also needs teachers who have conversations about race. Milner (2014) suggests that "educators can use conversations about race as powerful tools for engaging promptly in the analysis of the ways students experience school and classrooms" (p. 173). In the field of education, we should expect educators to engage in race discourse. Teachers and educators need to be prepared to do this type of work as well to understand the historical and deep constructs of race (Milner & Laughter, 2014). Currently, in teacher education programs, teachers are not always expected to do this type of work and are often held responsible for the achievement of our diverse students.

To further address the role of racial discussions in the classroom, Hollingworth (2009) compiled a case study of how White elementary teachers address conversations about race in their classrooms. According to Hollingworth, many White, female elementary teachers saw "school as a place where ideas about race and stereotypes can be interrupted" and believed that "racial tolerance is rooted in a 'color-blind ideology'" (p.

34). However, engaging in direct conversations about race or racial identity provides educators with an important perspective on how to gauge student learning.

Mensah (2012, 2016) also examines teachers' awareness and identity through the lens of positionality with different social markers, such as race, gender, etc. Mensah's (2016) study examined the positionality of pre-service teachers through a card sort activity to help teachers define who they are. The card sort activity consisted of 12 social markers that influence one's identity, such as race, religion, class, disability, gender, and political affiliation, Teachers were asked to put their top three social markers close to them, relating to their identity and how they define who they are. Both Hollingworth (2009) and Mensah (2016) indicate that teacher education programs need to tap into identity and race work with their teachers.

Teachers could also benefit from exploring the historical context of race within education for Black students beyond Brown vs. The Board of Education. For example, in exploring the historical context of race in education for Blacks, Milner and Laugher (2015) suggest that teacher education programs should have teachers read DuBois or Woodson or both. Both Woodson and DuBois provide historical context into what Black students have had to face in America. In many cases, Brown, Black, and other children from diverse backgrounds are still going through similar experiences. Woodson (1933, 2006) stated, "the thought of the inferiority of the Negro is drilled into him in almost every class he enters and almost in every book he studies" (p. 2). By examining the context of schooling for Black children in 1933, one could ask how much has changed for our students in their classroom settings. Arguably, things have not changed and there is still much that we need to do.

The work of W.E.B DuBois allows us to examine “dual citizenship” and “double consciousness” in how our students navigate their role of school and home (society) (Akom, 2008). The term “double consciousness” identifies the emotions that one feels when trying to rationalize their multiple selves in a society that is powered by whiteness. The diverse learners that we teach have all experienced “dual citizenship” in the internalized sense that assimilation in being a “good student” or “good scientist.” According to Brown (2004), our society requires students to have “dual citizenship” in a variety of cultural spaces and learning spaces. According to Leonardo and Grubb (2014), children learn what race means because of knowledge, and their own lives are interconnected to tell a story. Addressing “dual citizenship” among students, Kao (2000) stated, “adolescent racial and ethnic identity development is influenced by the ways that young people are motivated to achieve academically and to participate in groups that share their racial/ethnic identity” (p. 19).

Science Education and the Role of Race

Woodson (1933, 2006) stated that “the certitude of science or math has been unfortunate [in that] the approach to the Negro has been borrowed from a foreign method” (p. 4). This quote from Woodson addresses the conceptual conflict that exist between science education and race in terms of how students learn from their own culture and practices. For example, students have learned to construct knowledge that contradicts mainstream science (Lee, 1997). The notion of mainstream science and nature of science stems from western ideals which provides a conceptual conflict for students who are not a part of the dominant culture (Lee, 1997). Due to this, students could deter away from science education (Lee). By incorporating student's cultural (home, language, etc.)

experiences provides students with equitable learning experiences within science and allows them to achieve success within science education (Barton & Osborne, 2000; Lee & Buxton, 2011).

These racial inequities that Woodson (1993, 2006) addresses still exist in the realms of science education, where students from different cultures and backgrounds enter a community of practice in which ideas, beliefs, and discourse are not shared from their perspectives (Barton & Osborne, 2000; Lee, 1997). Emdin (2016) suggested that "when teaching does not connect to students, it is perceived as not belonging to them" (p. 39). The learning of students from diverse backgrounds is perceived as different because it does not contain western ideas about how science should be taught.

When teaching children, we need to consider their communities of practice. For example, Lave and Wegner (1991) suggested that learning "involves the whole person; it implies not only a relation to specific activities but a relation to social communities, it implies to become a full participant" (p. 53). This perspective on how they experience learning contradicts the notions of learning in mainstream science (Lee, 1997). As a result, gaps in science achievement continue to exist. being more thoughtful about the nature of scientific research.

Discourse and Representation of Race in Science Education

In our society, notions of race and its uses are complex because we tend to normalize race and the notions that surround it (Ladson-Billings, 1998). For example, we normalize race and its use by putting things into categories, such as the terms of *urban education* and *education*. Urban education is associated with being in the city or being in the "ghetto/hood" or with the children you are teaching, which are likely Brown (children

identifying as Caribbean or Latin X descent) and Black (children identifying as African American or African descent) children. The use of the term "urban" also implies a negative connotation for Brown and Black children. These perspectives on how the term "urban" is used suggests the contextual issues that are faced when teaching in diverse communities with diverse children (Mensah, 2013).

Within science education research, the concept of the urban has been used as a way to discuss race, culture, and poverty (Brown et al., 2016). It is important to think about the standards by which students of diverse backgrounds are discussed because of the messages about them that are being relayed. Walls (2016) completed a study in which he analyzed how race has been portrayed in nature of science (NOS) research over the past 5 decades. According to Walls, "the racial identity for 97% of all the participants went unreported; as this tenant denotes, any narrative that does not include the voices, stories, and input from students and teachers of color is, by definition, incomplete" (p. 1556).

Examining children from urban schools by using the term "urban" could reinforce racial inequities. In science education, race is associated with achievement in K-12 classrooms (Walls, 2017). Seeing race from this perspective creates a false binary that is all too familiar in our education system, as it implies that Black, Brown, ELL (English Language Learners), and students with disabilities will not do well in school or science.

Science Achievement Gaps

It is important to note that most research about science education gaps often examines middle to high school and does not address student's early educational experiences from elementary school (Lee & Buxton, 2011; Quinn & Cooc, 2015;

Banilower, 2019). To date, science achievement gaps are continuously divided by race and these results are from the National Assessment of Educational Progress (NAEP) and the Program for International Student Assessment (PISA) (Curan & Kellogg, 2016). These tests show large disparities in science achievement for Black and Hispanic students (Curan & Kellogg, 2016).

For example, Quinn & Cooc (2015) completed a study using the National Center for Education Statistics (NCES) standardized assessment. The results from the assessment illustrated gaps for students in grades 3 through 8 based on gender and race/ethnicity. The results from the study also indicated large racial gaps in the science assessment in grades 3 for Black, White, and Hispanics (Quinn & Cooc, 2015). As the students moved towards 8th grade, the gaps remained among Black and White students, while the Hispanic and White gap narrowed, and the Asian-White gap disappeared (Cooc-Quinn, 2015). Regardless of race/ethnicity of the student population, Cooc-Quinn suggests that these gaps take place in 3rd grade and that interventions should be made when students are at this young age.

Examining further the prevalence of the science education gap leads to further exploration of social justice disparities that are present in science education for children of color and children who attend urban schools (Ladson-Billings, 2006; Lee & Buxton, 2011; Quinn & Cooc, 2015; Walls, 2017). Bravo, Mosqueda, Solis, and Stoddart (2014) suggest that these disparities are created for Black and Hispanic students because they come from lower socioeconomic status, they lack access to science education, and achieve lower scores on standardized measures of science. Lee and Kuyck (2007) provide another suggestion to this disparity being due to a language barrier that hinders student's

access to science instruction. Moreover, Mensah (2010) and Berg and Mensah (2014) suggest that policies about time and practices are hindering the teaching of science at the elementary school level that then affects science education achievement. Thinking about these disparities challenges us to consider how to improve the scientific literacy for elementary-age children and to close the science education achievement gap for Black children.

Theories of Identity in Science Education

"I don't like science; I am not good at science; I failed science last year" (Geelan et al., 2010, p. 659). This student's sentiments illustrate how science failed this young girl. To change her narrative and perspective, Geelan et al. provided a variety of materials from her lab and asked her students a series of questions, such as "Do you know what these are?" and "What do you think will happen?" The young girl was then able to engage in NOS practices, which was reaffirming to her narrative that she could do science (Geelan et al., 2010). If this young person did not have that re-affirming experience with science, she may not have been able to embrace science as part of her identity.

Science instruction can lead to opportunities for students to learn about themselves as scientists. Identity development research has often focused on adolescents in secondary education because students in these grades have developed a personal interest in particular content and topics (Smith & Darfler, 2012). However, attention to identity formation should also include young children because of their experiences, or lack thereof, with science education.

According to Brown et al., 2004), “theories of identity have not been prominent in the discussion of scientific literacy and the consideration of identity can offer a missing lens for viewing students” (p. 781). Barton and Osbourne (2001) suggested asking the following questions: “Who are we thinking about when we dream of science for all?” and “What is science for all like?” (p. 13). To answer these questions, we need to envision the experience of science learning for young children. When exploring children’s identity formation within science education, the notion of identity is intricate because of the multiple perspectives by which identity is being examined.

For example, Gee (2000) defined identity as “being recognized as a certain ‘kind of person’ in a given context” (p. 99). Depending on the context, one will likely act differently. Gee explained,

> A person might be recognized as being a certain kind of radical feminist, homeless person, overly macho male, “yuppie,” street gang member, community activist, academic, kindergarten teacher, “at-risk” student, and so on and so forth, through countless possibilities. The “kind of person” one is recognized as “being,” at a given time and place, can change from moment to moment in the interaction, can change from context to context, and, of course, can be ambiguous or unstable. (p. 99)

Gee’s (2000) notion of identity illustrates how children have their interests in certain subject areas like science. Addressing the science identities of young children, Basu and Barton (2005) asked students to describe a scientist. Many of the students’ descriptors included references to “Einstein, lab coats, and goggles as science” (p. 467). This is a common depiction in the traditional draw-a-scientist-test (DAST) which illustrates the disconnection from science that children have in their homes to that of school structures.

In a study by Walls (2012), students’ oral descriptors of what a scientist looked like had similar notions of the “Einstein” image, but their drawings contained few stereotypes. Walls had a few racial stereotypes of the scientist, “drawings accompanied

by their narratives indicated an African American or at the very least, a non-White individual as a scientist" (p.17). However, in Walls's photo activity, at least 35% of the students had picked a white scientist as a "real" scientist. This highlights how we need to provide students with different narratives as to who "real" scientists can be. We can do this type of work by validating our student's prior knowledge.

As educators, our goal is to foster a community that encourages students to make sense of the world around them and to validate their existing knowledge. Our goal should include having students fit their knowledge about the natural world into a pre-existing curriculum (Driver et al., 1994). We navigate this by asking students what they know about science and how they experience science in their world. To provide students with access to science, Basu and Barton (2005) suggested educators use students' existing funds of knowledge to foster the connection between home, social life, and scientific knowledge. Researchers are still trying to foster a better understanding of theories of identity in science education, and Brown (2004) has examined theories of identity with children by examining their discursive identity frameworks.

Racial Identity Development

There are a variety of contexts in which racial identity is defined, but the commonality amongst the definitions of race is the idea that how one defines their race defines how they see themselves. Racial identity models have been used to understand how identity impacts one's experience but not how it impacts one's identity. Wijeyesinghe (2012) defined racial identity as the racial category or categories that an individual uses to name him or herself," and these are "based on factors including racial ethnicity, physical appearance, early socialization, recent or past personal experiences,

and a sense of a shared experience with members of a particular group" (p. 82). Wijeyesinghe's definition of racial identity allows us to examine how race is an important part of a child's cognition. Race is also an important part of a child's identity development because children are attuned to social cues regarding race.

According to Rowley, Burchinal, Roberts, and Zeisel (2008), children develop cognitive schema about race when they view the behaviors of certain members of their race. For example, children under the age of 10 already understand racial identity based on language use or skin tone. When children develop their own racial identities, they can overcome obstacles and achieve higher "self-resilience, self-esteem, and self-efficacy" (Murray & Alvarez, 2016, p. 17). This awareness among children brings their experience with race and understandings to the classroom. Byrd (2012) suggested that awareness is an important factor in children developing a racial identity. The dynamic nature of identity allows children to construct their identities within the contexts of race and science learning (Gee, 2000; Mensah, 2008). However, depending upon a child's racial socialization, experience, and identity development, the process could look different.

Sellers and Shelton (2003) completed a study with college students to examine their experiences with race and concluded that the students' understanding of their race and identity stems from experiences with discrimination and that these instances result in stress that has psychological outcomes. With elementary students, the same type of stress could apply to young children as well. For example, I had a Black student with negative experiences of the race that impacted her identity as early as kindergarten. This student would often feel discriminated against if a teacher did not call on her or called on a child

whom she would consider White. She would also make comments about not liking students she saw as not being a student of color because they were not nice.

These experiences in kindergarten stayed with her. This students' experience with race and her identity formation reminds us of how intersectionality influences the factors of children's experience with race, learning, and identity. Goodman and Jackson (2012) stated that "racial identity theorists are updating or creating conceptual models that capture the interrelationship between race and other social identities by incorporating aspects of intersectionality" (p. 216). Incorporating the intersectionality of the lived experiences of young children demonstrates that no analysis or label is complete in the sense of presenting a full picture of who someone is (Harris & Leonardo, 2018).

Intersectionality

Historically, intersectionality was used in the context of Black feminism and theoretical perspectives on social justice (May, 2015). While there is limited research on intersectionality being used to study science and racial identity development among children, it has been studied in science education among teachers (Mensah, 2012, 2016, 2018; Mensah & Fleshman, 2017; Varelas, 2012) and science educator's experiences in science (Parsons & Mensah, 2010).

The theoretical context of intersectionality approaches identities as emerging within an interlaced system of oppression (May, 2015). Intersectionality allows us to further understand racial identity by "describing and representing lived experiences of individuals and to link individual experiences to larger social, cultural, and institutional systems" (Wijeyesinghe & Jackson, 2012, p. 3). Within the world of social theory, intersectionality provides a new perspective on understanding social identities, power,

and the complexity of experiences (Gilborn, 2015; Harris & Leonardo, 2018; Wijeyesinghe & Jackson, 2012). Intersectionality also allows us to look for and examine identities and understand their formations, such as Black identity development, Latinx critical theory, critical disability theory (Harris & Leonardo, 2018; Wijeyesinghe & Jackson, 2012).

Currently, research on intersectionality theorizes race in education by focusing on understanding how identities are created (Coles-Ritchie & Smith, 2017; Harris & Leonardo, 2018). An example is the intersection of race, identity, and science and how a researcher might engage NOS interventions in science education when teaching young children (Walls, 2016, 2017). For young children, schooling is the crossroads at which they are exposed to more than one identity as they develop as learners and are asked to interconnect these identities.

Harris and Leonardo (2018) suggested that "the apparatus of schooling is an intersectional melting point, rather than the melting pot, of forces in the interpellation of the student as a subject on one hand and the nation creation project that is education on the other" (p. 19). When examining schooling experiences for young children from this perspective, the intersectionality of race, science, and identity becomes a guiding framework because it allows us to view educational problems, possibilities, limitations, and liberations (Harris & Leonardo, 2018).

Intersectionality and Family Social Structures

Research has been limited in discussing the intersectionality of race, science, and identity. However, Gilborn (2015) completed a study in which he examined the intersectionality of race, class, gender, and disability. He interviewed Black Caribbean

families who had children between the ages of 8 and 18 to examine the parents' experiences in navigating their child's special education needs. In the majority of cases, it was the parent who sought intervention for their child rather than the school. Gillborn's study concluded that the parents' experiences with receiving special education services for their children were insufficient even when they initiated contact with outside services. Gillborn's research can be used to demonstrate how the intersectionality of social identities affects students and their families.

Social structures inform our relationships, shared understandings, and culture within a community of practice (Lareau, 2003; Lave & Wegner, 1991). Due to the interrelationships among these structures, they inform us of who children are and how their identities are shaped. Lareau (2003) stated that "to understand the biography of an individual, we must understand the significance and meaning of roles he has played and does play" (p. 15). This quote resonates with the purpose of this current research because it illustrates how there are multiple layers of a child's identity and that, in turn, their identities are shaped by their families.

Lave and Wegner (1991) referred to this, as well, in addressing how members of a community of practice influence how knowledge and understandings are constructed. Within this social structure of family and community of practice, conversations about race stem from the racial socialization of a child's parents and how the parents and other family members see themselves (Tang, McLoyd, & Hallman, 2015). The researchers examined racial socialization influences on adolescents and parents through their discourse about racial identity and found that "correlations of racial socialization were higher for adolescents from families with high levels of communication than families

with low levels of communication" (p. 1147). Tang et al. suggested that families with high levels of communication also influenced adolescents' ideas of racial identity due to children internalizing their parents' beliefs. Even though their study only examined adolescents in eighth and eleventh grade, the same could be applied to younger children as well.

Intersectionality and Schooling

Racial identity models have been used to understand how identity has impacted experience, but according to Goodman and Jackson (2012) "racial identity theorists are updating or creating conceptual models that capture the interrelationship between race and other social identities by incorporating aspects of intersectionality" (p. 216). Within the framework of intersectionality, multiple identities are being examined as to how one is perceived from the lens of different social structures. This gives an understanding and knowledge to the identity development of young children and their lives (Renn, 2012). The context of schooling, family socialization (which includes race and science), and identity all impact the multiple identities of young children. This theoretical perspective of intersectionality "brings together both parts and whole of the self as was as the invidual in the context" (Renn, 2012; Torres, Jones, & Renn 2009, p. 585).

For example, the factors of identity, school, race, and family are relevant in the teacher education and science education communities (Basu & Barton, 2005; Lee & Buxton, 2011; Mensah, 2013; Moje et al., 2007; Varelas, 2012; Walls, 2016). The intersectionality of these factors demonstrates how schools are a part of a community that consists of family, students, and members who live in the community of the school (Leonardo & Grubb, 2014). For teachers and researchers, these factors provide insight

into the identity of a child. Identity must be the guiding framework for teaching science, especially for children from diverse backgrounds in urban settings (Mensah, 2013). If teachers are not prepared to examine the role and notions of identity, it will be difficult for them to establish a relationship with their students and the parents (Delpit, 2006; Rodriguez, 2015).

Family or Parental Involvement in Science

When examining children's conceptions of science and the construction of their own science identities, it is important for us to also to look at parents' involvement with science. Children notions of racial identity and knowledge due to the socialization of their parents, and identities of science are formed in the same way. Kaya and Lundeen (2010) completed a study that examined parents' attitudes and involvement with science education. This study came about due to a local university's partnership with a local school (Kaya & Lundeen, 2010). This is very similar to my research setting at Lincoln Elementary school. Lincoln Elementary and a local university implemented a science day in conjunction with pre-service science teachers to focus on the role of STEM teaching and learning. Kaya and Lundeen's study used family observations and exit surveys from parents who participated in a science night. They found that 60% of the parents did not like science as students and only 20% reported that they liked science in elementary school, while parents unilaterally indicated that the intervention had been valuable for their families and that they supported more science teaching in their child's school. The authors' analysis of the filed notes "revealed continuously high level of parent engagement with their children in the science activities" (p. 834). That study helps to

affirm the importance of parents having a relationship with the learning of science as a factor in helping to engage their children in learning science.

Another study that encourages the involvement of families is the work of Harackiewicz, Rozek, Hulleman, and Hyde (2012). In response to the ongoing achievement gaps in science and lack of science courses in high school, Harackiewicz et al. suggested that parents can influence students' motivation and aspirations when pursuing STEM. For example, if parents believed that science and mathematics are relevant, they would encourage their child to seek more courses in STEM in high school and change the perception of science that their child might have (Harakiewicz et al., 2012). Harackiewicz et al. concluded that the children of parents from high education levels took more science and mathematics courses, but the intervention of the researchers' brochures encouraging science also helped families because of the discourse that they created. Given the wealth of factors around race, racial identity, intersectionality, I choose to use critical race theory and sociocultural theory to guide study and analyze the dynamics of how these identities are shaped.

Theoretical Framework

The theoretical frameworks that helped guide this research are a sociocultural theory (Lave & Wegner, 1991) and critical race theory (Ladson-Billings & Tate, 1995). Both theories have been examined throughout this literature review to give insight into why the socio-political structures of race, learning, and family influence and motivate the diverse population of children in many urban classrooms. Through the lived experiences of the children and families who participated in this study, each theoretical perspective demonstrates an intersection among school, race, and power. These structures, then,

reveal a social process that prompts teaching and learning (Gilborn, 2015; Ladson-Billings & Tate, 1995; Lave & Wegner, 1991; Mensah, 2013). Both theories illustrate the importance of learning as an individual in a community of practice. To understand how race intersects with a child's identity, we need to understand their position in learning science and the relationship or impact of their family's participation through the lens of sociocultural theory and critical race theory.

Sociocultural Theory

Sociocultural theory describes learning as a process. The process of learning within a community is referred to as legitimate peripheral participation (Lave & Wegner, 1991). Lave and Wegner described this process as one "in which learners are engaged in learning through sociocultural practices" (p. 36). This process suggests that, regardless of the social world that one inhabits, learning is a trajectory that is part of one's identity. When this learning takes place and one's identity is fostered, the process is impacted by one's prior schema for understanding the world and their community (Lave & Wegner, 1991).

The sociocultural theory also illustrates how learning is shared across a variety of contexts, such as school or the community, in which one lives (Lave & Wegner, 1991; Mensah, 2013). Lave and Wegner (1991) stated that learning "involves the whole person; it implies not only a relation to specific activities but a relation to social communities—it implies becoming a full participant . . ." (p. 53). Lave and Wegner's explanation of a "full participant" provides a framework for examining how participation provides access to learning or a conceptual bridge to the absorption of information.

The idea of "full participant" also emphasizes how the mastery of knowledge and skills is attained through community practices. Examining learning from this perspective allows us to further examine the diverse learning experiences of young children and their varied experiences in the science classroom (Mensah, 2013). These examinations also provide insight into children's engagement in and construction of knowledge in the classroom (Mensah, 2013).

Critical Race Theory

The centrality of race within education aligns with Critical Race Theory (CRT) because it allows us to understand the hierarchical relationships of race within the power and social change processes (Delagado & Stefanic, 2017; Gilborn, 2015; Leonardo & Grub, 2014; Mensah, 2019). CRT allows us to confront and understand the narrative of race by speaking to a common narrative that often exists in the discourse of race and to examine race through the lens of power (Delpit, 1996; Milner & Laughter, 2015). CRT also provides the space for marginalized voices to be heard through the use of personal narratives (Williams & Evans-Winters, 2005). Placing race at the center of this research helps us examine how race intersects with identity, school, and family (Coles-Ritchie & Smith, 2016).

In Delgado and Stefancic's (2017) tenets of CRT, race is difficult to address because it is not acknowledged: Race was merely created to categorize differences. In the present study, all the children had a relationship with race in the context of their identity, context of schooling, and within their family, and this relationship is present in all aspects of their identities. Using CRT in this study was important so that I would not advocate a colorblind approach in teaching science to children from diverse backgrounds but,

instead, address race at the forefront (Milner, 2005; Milner & Laughter, 2015; Wijeyesinghe & Jackson, 2012). According to Wijeyesinghe and Jackson (2012), "CRT embraces an epistemology that values individual knowledge based on the experiences of people of color" (p. 23). This illustrates that, as educators, we need to bridge the present gaps in making science education more accessible and equitable for diverse learners (Walls, 2016). This work includes addressing the fact that we do not live in a post-racial society as some would like to believe. While racial progress has been made, segregation is now existent in forms of class oppression against individuals from diverse groups, which include students and their families (Delgado & Stefancic, 2017).

In summary, teachers need to reflect on their positionality concerning different social markers and race (Leonardo & Grubb, 2014; Mensah, 2016). We need to continuously examine these roles for our teaching practices and reflect on them for us to become more aware as practitioners in our field. By embracing our awareness, teachers are then able to have an affirming lens of how they view their students and support their achievement (Villegas & Lucas, 2002). However, while teachers may reflect on their awareness, we must continue to address the missing dialogue of race in teacher education programs (Williams & Evans-Winters, 2005).

Also, discussing children's racial identities in the structure of schooling is not meant to hinder a child but to help them to fully embrace the individuals that they are. According to Souto-Manning, Llerena, Martell, Maguire, and Arce-Boardman (2018), "children are cultural beings with amazing histories and practices, and no two children are the same" (p. 9). Thinking about children from this perspective demonstrates the

importance of examining the racial identity development of young children and their constructions of science.

In Chapter III, the methodologies and research design are discussed. A qualitative approach such as narrative inquiry was used in this study to allow both children and parents to share their stories and voices (Creswell, 2013). A narrative inquiry was chosen to provide first-person accounts as a way to collect data (Boeije, 2010; Creswell, 2013; Merriam & Tisdell, 2016).

Chapter III

METHODOLOGY

The purpose of this qualitative study was (a) to understand elementary children's perspectives about racial identity and their notions about race, (b) to examine the learning of science that takes place in the children's schools, and (c) to explore the role of parent engagement with their child's learning and their notions of science. In exploring children's racial identity and science identity, a key paradigm in this relationship is parent and family engagement with the child's schooling. This study provides insight into children's ideas and thoughts from their voice and how they see the world and science around them. In this chapter, I describe the research approach to address the research questions of this dissertation:

1. How does the role of racial identity development influence children's approach to learning science?
    a. In what ways does racial identity development encourage or discourage students access to learning science?
2. What role does family socialization have in how their child's racial identity? development and science identity development?

Research Design: Mixed Methodologies

Morse (2018) suggested that mixed methods in qualitative research "brings qualitative inquiry more closely into a complexity that resembles reality, unpacking the

social theory that shapes the world" (p. 804). This suggest that mixed methods draw on the varying perspectives of individuals' intersectionality, which includes society, reality, and self (Charmaz, 2006). For mix-methodologies, the notion of perspective provides a link to how a theory is developed, as demonstrated in the process of triangulation, which illustrates a systematic triangulation of perspectives (Flick, 2018). According to Flick (2018), "the term *perspectives* refers to different ways of addressing a phenomenon" (p. 454). Flick argued there are three ways in which perspective can be used, such as the "subjective perspective of a subject," "institutional routines," and "methods that are closely embedded in the theoretical methodological background in which they are based" (p. 454). For this study, I examined and explored participants' perspectives on their racial identity development and their science identity development.

Mixed methods draw from both quantitative and qualitative methodologies in which the findings were used to draw corollary approaches from both, and all, methods used (Boeije, 2010). In this study, qualitative data were collected, first, through narrative inquiry, then they were used for the quantitative design of Likert-surveys (Creswell, 2015). Both design methods provided a cross-sectional examination of the role of race by providing further information about the child and parents' sentiments about race and the role race plays within the social constructs of schooling and home. These methods helped me to explore the intersections of race and its influences on students' identities and their science beliefs.

Qualitative Methods

A qualitative approach was used in this study to allow children and parents to share their stories and express their voices (Creswell, 2013). Qualitative approaches in

science education allow researchers to gather information on participants through dialogue in natural settings (Creswell, 2013; Dezin & Lincoln, 2018; Erikson; 2018). According to Dezin and Lincoln (2018), qualitative research is a

> [s]situated activity that locates the observer in the world. Qualitative research consists of a set of interpretative material practices that make the word invisible. These practices transform the world into a series of field notes, interviews, conversations, conversations, photographs, and recordings. (p. 10)

Engaging individuals in natural settings allows researchers to move beyond the epistemological and methodological approaches traditionally studied in science education by moving outside of the lab and into the context of the real world (Dezin & Lincoln, 2018).

For the purposes of this study, qualitative research methodologies were used to gather and explore children's narratives about their own experiences with learning, science, and conversations about race. The study took place in a natural setting, such as their school or local university. They highlight the interconnected components that give the participants meaning and help us to understand the role of children's racial identities and how those influence students' conceptualizations of science.

Quantitative Methods

For the purposes of this study, a quantitative Likert-survey was created to explore students' and parents' attitudes regarding race and science identity. This survey was used to examine students' sentiments and explore themes, such as differences and similarities that students have about the different statements in the survey. Inferential statistics were drawn from the survey to address the frequencies of each response.

Another Likert-survey was created for the parents. This survey was used to examine the parents' sentiments in regard to their own experience with science, the

children's experience with science thus far and difficult conversations (i.e., race and racial identity). Inferential statistics were also drawn from the survey to address the frequencies of each response.

Field Setting and Participants

The study took place at a small progressive elementary school located in New York City (NYC) that is referred to as “Lincoln Elementary school” (all proper names are pseudonyms). Lincoln Elementary school was also chosen as the site for this study due to the qualitative pilot work that was completed in Spring 2016. The pilot study focused on how teacher identity impacts the learning of science among elementary students. From the pilot study, I learned that theoretical connections between teacher identity and student motivation helped with students’ science identity.

Lincoln Elementary school also has an ongoing relationship with the local university. Which helps to facilitate and integrate science instruction with the school by working with pre-service, novice, and veteran teachers. Additionally, in comparison to the district and statewide grade 4 science results, Lincoln Elementary school tends to do better than the state’s mean, with a mean score of 81 for the 2016-2017 school year. Out of 26 students who took the test that school year, 88% were at proficiency; this breaks down to score at level 2 of 3 (= 12%), at level 3 of 10 (=38%), and at level 4 of 13 (= 50%). According to the NYC Department of Education and Inside Schools, the students’ demographics are as follows: Asian = 4%; African American = 20%; Hispanic = 53%; White = 16%; and Other = 6%. Lincoln Elementary school serves both general education and special education students. The school also has a significant number of English Language Learners (ELL) in grades K-5.

To target the participants for this study (Appendix F), convenience sampling was used. Convenience sampling refers to a researcher selecting participants based on certain factors, such as location (Merriam & Tisdell, 2016). Convenience sampling was used for this study because of my former relationship with Lincoln Elementary school as a classroom teacher. Interested participants emailed me and scheduled appointments based on their availability and time at either Lincoln Elementary or the local university. The majority of the students who responded attended Lincoln Elementary school. Six of the students who participated in this study also participated in the local university's Science Day initiative with Lincoln Elementary school. Two additional students attended an independent school located on the upper west side of Manhattan.

This study targeted elementary children in grades 3-5 to address the gaps in literature about the impact of racial identity on science identity. Students in grades K-2 were omitted from this study because of the developmental appropriateness of the tasks that students were asked to complete which were to engage in discourse on topics they may not have been exposed or have the language to discuss. In grades 3-5, all NYC public school students are expected to take a science class, have had some exposure to science, or have already taken the New York State (NYS) fourth grade science exam. Participants were recruited via announcements by flyers and emails to the parent association of Lincoln Elementary. Interested families sent email correspondence to verify their participation and a scheduled meeting time was arranged with them. All participants received $15 for their completion of the study.

There were 20 participants who signed up for the study, which included 10 children and 10 adults (parents of the children). There were 6 boys, 4 girls, and 10 female

adults (parents). The students ranged in ages from 9 to 11 years old. The parents ranged in ages from 36 to 50 years old. Students and their parents identified with a range of ethnic backgrounds (see Table 3.1).

Table 3.1

Child Participants

Participant	Pseudonym	Gender	Race/Ethnicity*	Age	Grade
1	Samantha	Female	Latina	10	4th
2	Robert	Male	Biracial (Japanese and Antiguan)	10	5th
3	Lynne	Female	Biracial (White/Black/Spanish)	10	4th
4	Michael	Male	White	8	3rd
5	Jamir*	Female	African American	9	4th
6	Alicia	Female	African American	11	5th
7	Trevor	Male	Afro-Latino	10	4th
8	John	Male	Asian	9	4th
9	William	Male	White	8	3rd
10	Maya	Female	Black/Haitian	11	5th

*Self-identified
**Sibling to Alicia

Table 3.2

Parent Participants

Participant	Race/Ethnicity*	Age Range	Gender
1	Latina/Hispanic	41-50	Female
2	Japanese	41-50	Female
3	Caucasian	41-50	Female
4	Caucasian	41-50	Female
5	African American	41-50	Female
6	African American	41-50	Female
7	Afro-Latina/Hispanic	41-50	Female
8	Asian	36-40	Female
9	White	36-40	Female
10	Black/Haitian American	41-50	Female

*Self-identified

Data Collection

The data for this study were collected in Spring 2018. Before scheduling one-to-one meetings with the participants, I conducted observations at Lincoln Elementary School to build rapport with the schools' new administrators and students. I also wanted to gain a sense of the school culture and of how science is integrated into the school's K-5 curriculum. I made classroom and school observations during the school's Science Week. This was a week planned by the PTA and a teacher/coordinator of events. For that week, students in K-5 had an opportunity to engage in the following activities: terrariums/seed bombs, a third-grade science fair, microscopes and cells, wetlands presentation, and a bio bus.

Before this, Lincoln Elementary School had a partnership with the local university to create a "Science Day" each spring. This year, the school wanted to continue that tradition in coordination with the PTA and make a Science Week an integral part of the school year. My observations took place in the classrooms and a newly built science room. Many classrooms were engaged in learning from the parent science teachers. The third-grade class, in particular, was preparing for their participation in the science fair.

Data Collection Protocols

For this study, four primary data sources (both qualitative and quantitative) were used: clinical interviews with photo elicitation, a survey, a drawing task, and a parent involvement survey. Audio recording was a part of the data collection for the clinical interviews, surveys, and drawing tasks. A secondary data source was used, which was observational memos from my field notes.

Clinical interviews. Clinical interviews (see Student Interview Protocol, Appendix G) were conducted with each student (n=10). The interviews were digitally recorded and lasted between 20 and 30 minutes. Students were interviewed using Ginsburg's (1997) clinical interview framework, a valid and reliable way to measure background information and educational priorities. Ginsburg's structured framework for clinical interviews with children considers the following: the zone of proximal development of children, understanding thinking and learning potential, examining the fluid nature of thinking, and personal constructions. For the purpose of exploring each participant through this approach, a structured interview protocol was used.

The Student Interview Protocol provided the sequence procedure for how I interviewed each participant and what they could expect from our time together during the interview (Creswell, 2013). During the clinical interview, parents were present while students completed all parts of the study. Students were asked for general background information about their grade levels, favorite foods, birthdays, etc. (Cameron, 2005; Ginsburg, 1997; Merriam & Tisdell, 2016). This background information was helpful to foster a sense of ease among the students and making them feel comfortable sharing information with me.

The clinical interview consisted of questions that pertained to science and race in the context of their school and home structures. Probes were also used to clarify certain answers that were given and to ask for more information (Ginsburg,1997; Merriam & Tisdell, 2016). The one-to-one interviews (along with their parents) were conducted with the students for about 30 to 45 minutes. The protocols for the interviews were based on the types of task that each participant was completing during their time with me. The

clinical interview questions were open ended and semi structured. The interview questions were structured in this way to provide flexibility in how the participants could respond and for me to learn more about the participants' perspectives (Merriam & Tisdell, 2016). After the clinical interview, a photo elicitation was used to engage in more dialogue about science.

Photo elicitation. Photo elicitation (Appendix H) was used as a visual format to collect data in how the students were able to see science out in the world (Zinjarwad, 2018). During the photo elicitation, participants were shown pictures taken by the researcher and asked to discuss the photo and make observations. For each photo, specific questions were asked such as, what about this photo makes you think of science? And where do you see science in this photo? Each photo elicitation took between 10-20 minutes to complete.

All questions from the photo elicitation was audio recorded (Creswell, 2013; Ginsburg, 1997; Margolis & Zinjarwad, 2018; Merriam & Tisdell, 2016). The three photos that were used in the study were aligned to the NYC fourth grade science test domains, which were earth systems, energy, and the processes that shape earth. The photos were also used to informally assess the content knowledge of basic nature of science practice skills.

Drawing tasks. The students completed two drawing tasks. First, the drawing procedure of Draw-A-Scientist-Task (DAST; Appendix J) was used to identify participants' personal views of and perspectives on what a scientist looks like. The DAST was used in a classical study conducted by Chambers (1983) to investigate children's perceptions of science. The DAST drawings provide insight into students' thinking about

science and those who teach science. The DAST was given to participants upon completion of the clinical interviews with photo elicitation. Participants were asked to complete a written explanation of their drawing to describe what they had drawn. Completing the DAST took between 10 and 20 minutes.

Second, students also participated in the Drawing-Elementary-Science-Teacher-Ideal-Not (DESTIN; Appendix K). The DESTIN procedure (Mensah, 2011) is a tool for examining identity and diversity issues. Traditionally, the DESTIN procedure has been used to study pre-service teachers' perceptions of science teaching derived from their own personal experiences of science. In this study, the DESTIN drawings were completed to explore children's position on what science teaching should not look like. The DESTIN drawing task was given to all students after the clinical interviews, photo elicitation, and surveys were completed. Students were also asked to write an explanation of their drawings (Mensah, 2011). The DESTIN drawings, for which students drew a picture of their ideal science teacher, took between 10 and 20 minutes to complete.

Child survey. The child survey (Appendix I) used was an 8-item Likert measure of conversations/comfort about race, racial identity, and science. Participants indicated their agreement with items on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*). The Likert measure included sentiment/attitude statements that addressed racial identity, student identity, the contexts of the schooling and home, family, and science identity. Follow-up questions were also listed on the survey and utilized to elicit more information. The survey took about 20 to 30 minutes to complete. Audio recording was used to record all responses.

Parent involvement survey. The parent survey (Appendix L) consisted of a 30-item Likert measure that addressed sentiment statements about parent involvement, parents' own perceptions of science, and homework participation with their child. Participants indicated their agreement with each of the survey items on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Demographic information was collected from each student during the clinical interview (Appendix G) portion of the study. For parents, their demographic information was collected on the Parent Survey (Appendix L).

Observational memos. I used the process of memoing to keep reflective notes about my observations at the school and my participant observations while they engaged in the study. Creswell (2013) suggested that memoing allows the researcher to write down ideas that they are having while they are immersed in their study and the different ideologies that form while they are conducting the study. For example, during each clinical interview, I asked the question, "How would you describe yourself?" In my memos for each participant, I reflected that this question was tricky because it did not ask participants to describe themselves by their traits or physical attributes. Some participants had asked which I had meant, and I replied that they could choose to tell me either one. However, all of the participants described their character traits according to how others viewed them.

Merriam and Tisdell (2016) suggested that memos are descriptive and reflective. In the survey portion of the clinical interviews, I provided the Likert-scale statement, "I feel like I can talk my family about anything." In my memos, I reflected on my observations of the participants' affects or demeanors. The memos also helped to guide me as I met with the next participant (Boije, 2010). For example, I wanted my first two

participants to engage in more dialogue during the clinical interview, but the prompts that I was using were not giving me information. Due to that reflection, I was able to elicit effective prompting to gather more information from the participants about their experiences. In the qualitative data analysis section, I discuss further how I used coding of the memos to develop my conceptual framework for addressing the study's research questions.

Qualitative Data Analysis

To understand the participants' perceptions of their identities and intersectionality with their social structures, triangulation, the researcher's positionality, observational memos and coding were used to analyze the data (Boeije, 2010; Merriam & Tisdell, 2016). A grounded theory constructivist approach was used to provide context for my research questions as my process for data analysis. According to Charmaz, Thorne, and Keane (2018) a constructivist grounded theory approach "recognizes how historical, social, and situational conditions affect these actions and acknowledges the researcher's active role in shaping the data and analysis" (p. 412). For the purposes this study, this implies that there are different positions that we take to examine different constructs, such as race, community, education, and family, which allows us to recognize multiple realities at a micro, meso, and macro level to understand different constructs (Charmaz et al., 2018). For example, there are many entities to examine that cause the achievement gap within science education. On a micro level, one perspective is to examine race; on the meso level, we could examine the NOS and learning; and on the macro level, we could examine funding inequities in education.

My role as the researcher was to understand how and why participants make meaning of their experiences within these different social constructs; my role was also to examine my own preconceptions about these structures, as noted earlier (Charmaz, 2006). Understanding my own preconceptions helped me to explore the larger paradigms and hidden positions within these structures.

As I met with each participant, my initial focus was to understand their racial identity and their science identity. In further examining the roles of race and science, other structures presented themselves, such as the role of their schooling and family, which influenced their identities. These connections also highlight the institutionalized power within the social contexts of school, home, community, and the role of science education (Charmaz et al., 2018). For example, the role of the local university and its relationship to the school helped to further build the students' science identities. This, in turn, influenced the development of the school's Science Week.

Clinical Interview

All audio recordings of the clinical interviews and follow up questions from the survey were prepared for data analysis through transcription. Two methods were utilized for transcribing: typing and saving them on the computer and Google voice typing saved to a Google document. I used these methods to then generate transcriptions to do data analysis on the text from the audio recordings.

All interview data collected at the local university and the school were transcribed; any identifying information was deleted, and each participant was assigned a code. Each participant was also given a pseudonym. Each participant's data sets were segmented and compiled through open coding. Open coding is done in the beginning of a

data analysis to explore emergent categories or themes presented within the data (Charmaz, 2006; Charmaz et al., 2018; Merriam & Tisdell, 2016). Line-by-line coding was used to examine the different actions and meanings related in the transcriptions (Charmaz, 2006; Charmaz et al., 2018). Then, focus coding was completed for each interview transcript to capture the conceptual definitions within each transcript (Charmaz, 2006; Charmaz et al., 2018). Triangulation of the data was relevant for this study because, in studies using mixed methodologies, triangulation offers a way to understand the processes of both methods and to explore different perspectives for examining the research questions (Flick, 2018).

Drawing Task

The Draw-A-Scientist-Task (Chambers, 1983) was used to explore the perceptions that the child participants had about what a scientist looks like. Specific indicators were used to identify the basic standard image of a scientist, as outlined by Chambers: (a) a lab coat, (b) eyeglasses, (c) facial growth, (d) symbols of research, (e) symbols of knowledge, (f) technology, and (g) relevant captions. Each drawing was assessed based on Chambers' indicators. An average score was used as the final score for each drawing

Next, each drawing was accessed and coded using a modified version of the traditional DESTIN procedure. The DESTIN procedure (Mensah, 2011) was modified for the purposes of this study to explore how children see what scientist teaching is not. The following criterion had three indicators: the position of teacher and students, the classroom environment, and the presence of science, as summarized in chapters IV and V. The open-endedness of the drawing task allowed students to add as little or much to

the page or drawing as they desired. Artistic ability was not important. An analysis of the drawings showed the children's perceived identity within science and perceived role of the teacher. Additionally, the majority of the drawings illustrated science taking place within the classroom.

Diagramming

Diagramming was also used in conjunction with coding to identify themes that were emergent from the data. Charmaz (2006) defined diagrams as "various types of diagrams, including maps, charts, and figures, to tease out relationships while constructing their analyses and to demonstrate these relationships in their completed works" (p. 117). For this study, diagramming was used to help me see the different relationships among the emergent themes from all the data sources. The emergent themes that I found were race, science, and school/community, which connected strongly to the research questions. Within each theme, there were different positions and within each position there was a process (Charmaz, 2006). For example, if looking at the theme of community, the roles of school, teacher, and family all gave students access to and agency within science. Diagramming was also used to show how the students saw themselves as racial beings and how they viewed discourses around race.

Quantitative Data Analysis

Quantitative data analysis used descriptive/inferential statistics for both the Likert-surveys that both child and the parent completed during our study. The child survey (Appendix I) consisted of an 8-item Likert measure. Participants indicated their agreement with items on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*). The

agreements from each statement were than analyzed to address themes of racial identity, student identity, the contexts of the schooling and home, family, and science identity.

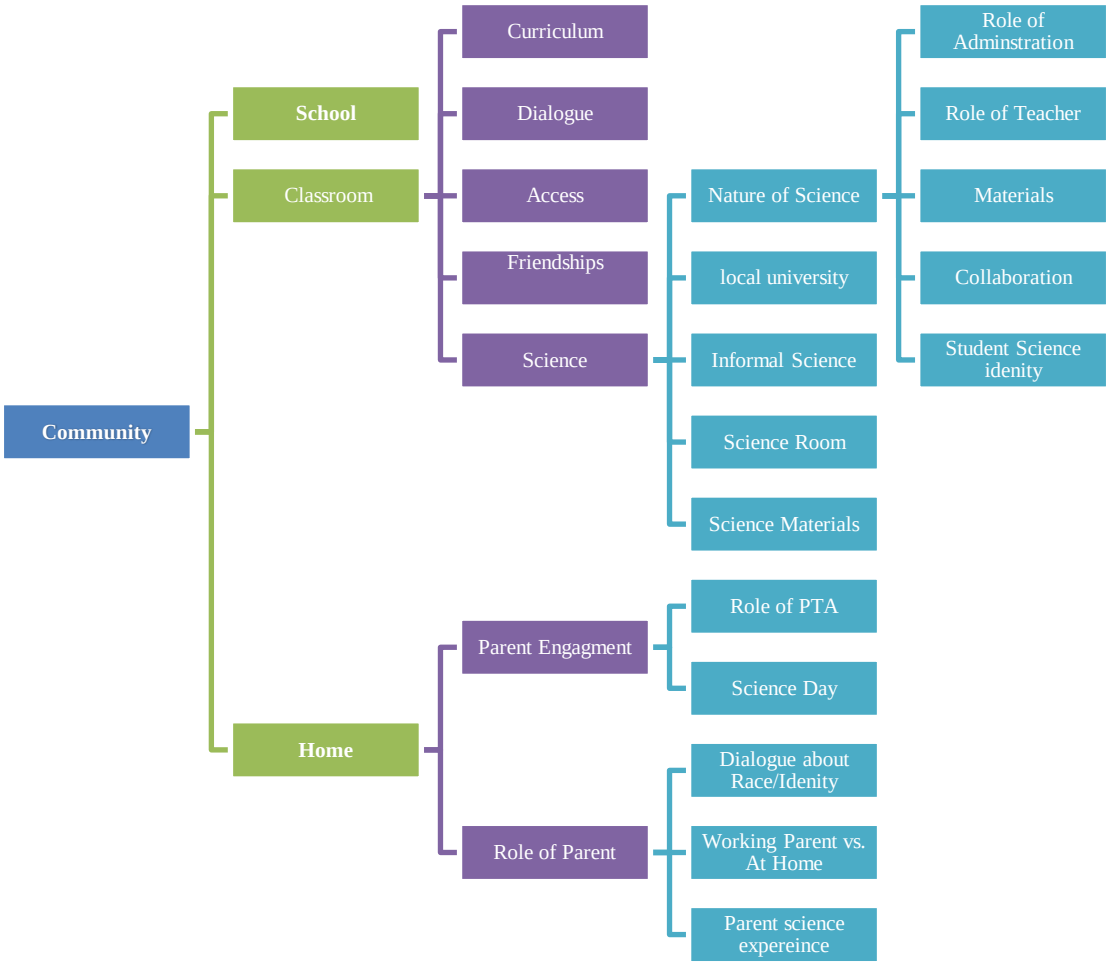

Figure 3.1. Diagramming example.

Role of Researcher and Biases

My role in this study was both as participant and observer. Merriam and Tisdell (2016) described this role as involving the "researcher's observer activities, which are known to the group are subordinated to the researcher's role as participant" (p. 144). My dual role allowed me to participate at the field sites with the participants to help me

become less subjective as I was analyzing the data (Creswell, 2013). This method of collecting information also allowed me to describe what was happening, what the children were noticing, and what motivated their points of view (Boeije, 2010). The role of the researcher as participant and observer minimizes the power relationships that often exist among participants and researchers (Creswell, 2013). The participants seeing me in this role helped to foster a sense of collaboration among the participants and myself. Within this role, I also wanted to learn from the participants' experiences. Although I took on the dual role of researcher and observer in this study, I maintained a separation between both roles.

My position with respect to race in the context of my own home and schooling experiences has impacted me in many ways. Conversations about race and racial identity are sensitive topics, and they are even more sensitive when children are the focal point. I wanted to address racial identity and race to understand if it inhibits students' access to science. Through my coursework and teaching experiences, I have witnessed how providing access to science prepares students for success and empowers them with the tools they need to be active citizens in our society (Guzey, Harwell, Moreno, Peralta, & Moore, 2016).

My personal experiences in public education have also influenced my position in relation to science education and young children. In my opinion, all schools, especially elementary schools should provide access and opportunities to learn science and to grow their science identities. Due to my perspective on and experience with science education and racial identity, this study could be seen as being conducted from a biased approach. While engaging with the participants, I was aware of their educational experiences due to

my role as a former classroom teacher at Lincoln Elementary School, and I had also taught a few of the student participants when they were in the second grade. This could be seen as bias due to my prior relationship with the students. One student had also participated in the pilot study. I was, however, explicit with the children and the families about my role as a participant researcher for this study. Another potential bias my approach were my assumptions regarding racial dialogue in the classroom. I assumed that students were having conversations about race in the context of the schooling environment and that students had all participated in a social justice curriculum.

Elements of Rigor

To establish rigor, I wanted to be mindful about the representation that would be conveyed of each of the participants. To accomplish this, both hard and soft data were used. Morse (2018) stated that hard data are "facts (i.e., demographic data) in the narrative, dates, [and] places used for description" (p. 807), while soft data are "phenomena that are experiential, such that the only data available are reports from those who have a certain experience" (p. 808). The hard data for this study included demographic information. Soft data included the clinical interview, photo elicitation, the surveys, and the DAST and DESTIN drawings.

All data sources that included both hard and soft data were stored electronically on a secured laptop (Boeije, 2010; Creswell, 2010). All participants were given identification codes during data collection and pseudonyms were used to protect their identity and confidentially. Pseudonyms were used as identifiers for the interview places as well, also to ensure confidentiality and anonymity (Boeije, 2010). For ensuring validity and reliability, the codes of ethics were used as outlined by Institutional Review

Board (IRB) of Teachers College (Appendix A) and the New York Department of Education (Appendix B). All parents signed an informed Consent Form providing consent for their own and an assent form for their child's participation. Each child signed a child assent form (Appendix C), as outlined by the IRB of the New York Department of Education (Creswell, 2010). Each student participant received $15 cash for their participation.

In promoting validity and reliability, several strategies were used, including triangulation, reflexivity, rich/thick descriptions, and maximum variation (Merriam & Tisdell, 2016). Triangulation was used in this study to examine multiple data sources for the purpose of crosschecking different observations (Boeije, 2010; Flick, 2018). Reflexivity was used to provide context to the study. Creswell (2013) suggested that "how we write is a reflection of our interpretation based on cultural, social, gender, class, and personal politics that we bring to the research" (p. 214). Reflexivity was used to address and examine my own personal biases to help position my stance while conducting this research. Hence, I used my own experiences to shape my theory and understanding each of the research questions (Boeije, 2010; Creswell, 2013; Merriam & Tisdell, 2016). Also, the use of rich and thick descriptions throughout this study allowed me to give context to the methodologies and findings (Merriam & Tisdell, 2016).

Finally, maximum variation was used to document diversity and identify patterns among each participant (Merriam & Tisdell, 2016). I anticipated challenges in conducting this study due to conversations about race and our current political climate. Conversations about race and racial identity are sensitive topics, and they are even more sensitive when children are the focus. Due to these factors, I was concerned about

whether participants would be honest and forthcoming about their experiences. In the next two chapters, I present the findings of the research.

Chapter IV

FINDINGS

The Role of Racial Identity

Critical Race Theory (CRT) (Delgado & Stefancic, 2017; Ladson-Billings & Tate, 1996) was used to examine and situate the context of race with the children's identity. CRT was also used to examine the realities and experiences of the children and families. Examining race through this lens provides a social justice view of education for thinking about how the children understand race in the science classroom. In thinking about the children's experience regardless of their race or ethnicity, there is this notion of power that exists in the context of racial dialogue in the classroom.

Children's Self Identification

There were two components that emerged from the children's responses regarding racial identity: racial/ethnic identity and self-identification of one's identity. For five of the children, their racial identification and awareness varied. For example, five of the children were able to state their ethnicity, while five of the children were not able to do so or referred to their parents for clarification about their ethnicity. For example, Robert expressed that his mom was from Japan and his dad was from Antigua. Robert did not mention that he considers himself biracial. Perhaps he did not use this term to describe himself because he does not know what the term means, or his family does not use this term to describe his race or ethnicity.

In another instance, Samantha was unable to tell me how she self-identified. I expressed that she could choose not to answer if she was unsure, and she decided to do that. When asked where her family came from, Samantha had to look to her mom. Her mom reported that their family was from "New York, Honduras, Puerto Rico, and Dominican Republic." Samantha added that she had family from "Brooklyn" as well. From Samantha's mother's response, one could assume that Samantha might identify as Hispanic (on the parent survey, Samantha's mother listed herself as Hispanic). However, Samantha was not sure of or could not give her racial/ethnic identity. Similarly, when Participant 7, Trevor, was asked about his ethnicity, his mom reported that he was Puerto Rican. Trevor did not have a chance to answer this question independently. Therefore, when students were asked them to give their ethnicity, they appeared to be confused by the term, but they also asked their parents for clarification. If I would have explained the "ethnicity' in detail or provided an example, I wonder if the participants would have been more familiar with the term.

In further addressing each of the participants' identity, each child was asked "How would you describe yourself?" in the clinical portion of the interview. Many of their responses reflected the children's interpersonal skills as individuals and learners. Very few mentioned or talked about their racial identity. For example, Alicia expressed, "I would describe myself as a very engaged learner because I like learning a lot and it's really fun. I guess I'm very nice, too." John stated, "I could describe myself as being kind to most people especially my family." However, Maya expressed,

> I would describe myself as a smart person, a person of color. I would describe myself as a friendly person. I would describe myself as a funny person. I would describe myself as a good person.

According to Tang et al. (2016) and Nelson et al. (2018), children often internalize their ideas of race due to their parent's own beliefs about race. This could be one reason why Maya saw herself as a racial being.

The absence of skin color as a descriptor was markedly noted with the children in the clinical portion and Likert-survey. For example, on the survey statement 4: “I feel comfortable talking about topics like skin color”, the responses were mixed: 10% answered definitely disagree, 10% disagree, 40% neutral, 20% agree, and 20% definitely agree. This illustrates that only four children felt comfortable in discussing this topic. The children were asked follow up questions as to why they felt comfortable, or not, talking about topics like skin color. The responses from each participant varied as to why they felt comfortable or not. The following is an excerpt from the interview with a few of the participants:

Samantha:	It’s rude.
Robert:	It is important to know, but rude.
Lynne:	It makes me sad. I don’t like to talk about it, especially when they say that Black people were slaves and White people got everything and people doing things they didn't do, but I also feel good about it because you got to learn more about like what people. Sometimes, if someone says something like, If I am Black or White or what is my skin tone?
Michael:	I don’t know if I will hurt someone’s feelings.
Trevor:	Feels weird because it does matter, makes you upset when people talk about one race being better . . .
John:	Ok topic for me, because it is something that won’t disappear.
William:	It depends.
Maya:	Helps me feel more confident, more comfortable with myself. It is important because you get a sense of how different races feel.

Within these excerpts from the children's interviews, the majority of the children had associated the skin tone topic as "rude" and talking about it made them feel sad. I wonder if these feelings stem from the current political context regarding race. In the news, race has been discussed negatively. Brown people were referred to as criminals for wanting to enter our country. Also, there is the ill-treatment of Brown people outside the U.S. placed in detention camps. This ill-treatment of Brown people from Mexico and South American paints a sad picture for us who value acceptance and diversity. From a young person's perspective who lives in a diverse neighborhood in NYC, then race and skin tone could become topics of sadness.

This further illustrates that we need to examine our children holistically in regard to their community of practice and what they are familiar with (Lave & Wegner, 1991). For example, the news, social media, and YouTube have all illustrated what has been happening to people who are not US citizens who are trying to enter the U.S. Perhaps young children have also seen this on the news or overheard discussions on these issues. Making connections between what they see on TV and skin color and skin tone might be another reason for their sadness. This could also impact their parent's hesitation in having difficult conversations with their child about race or skin tone.

The parents were asked a similar statement on their Parent Survey: "I have difficult conversations with my child regarding race." The parents' responses were similar to their children's answer: 10% answered definitely disagree, 10% disagree, 20% neutral, 20% agree, and 40% definitely agree. This demonstrates that six of the parents feel comfortable, yet five of the children felt discomfort. From the analysis only half of the children and parents find comfort and discomfort. This may be an opportunity for the

school and/or teachers to promote conversations about race and/or difficult topics. The school could incorporate this topic in a parent workshop, for all parents and children.

Racial Discourse in the Classroom

In the clinical interview, two of the students reported that they did not have conversations about race at school. While the other eight participants reported that there were conversations about race, these conversations consisted of topics regarding slavery, the Civil Rights Movement, racial affinity groups, and President Trump. The students' responses present a variety of social and academic influences on their learning and understanding about race. For the dialogues about race that students reported having at school, two students reported that when conversations about race or skin tones were held in the cafeteria, there were fights. The following is an excerpt from the interviews with three participants:

Lynne: Sometimes, at lunch, someone at our table may say something about other people's skin tones or skin colors. Like, if they say that your skin tone's better than mine or yours is ugly and mine is better. Then people just, like, start getting angry and then there's a whole fight at the table. Then the teacher or aide will come over and talk to us.

Michael: So weird. Sometimes two people get into a fight and then my teacher tells us about stuff that Donald Trump is doing.

John: Yes, we have a special RJA (Racial Justice Advocacy). We have affinity groups. I go into them every other lesson. It is people who don't identify as White. It is for kids of color who want to talk about what they experience. RJA is someone else we can talk to, but I can also talk to my classmates and teacher.

In conversations about race in the classrooms, many students reported a historical narrative of race such as the Civil Rights Movement. The students also discussed Martin Luther King, Jr. and Rosa Parks. However, there was a missing dialogue on the current racial context within schooling such as school segregation especially here in NYC. Additionally, both Maya and John had a different experience in how race was discussed in their classrooms. Maya and John attend the same private school located on the upper west side in Manhattan. Conversations about race are addressed in their racial affinity groups at their school. John racially identifies as Asian American and Maya racially identifies as Haitian/African American. Both students began attending the affinity groups when they started at the school in first grade.

Racial Discourse at Home

When students were asked, "Do you talk about race at home?", 10% of the students reported strongly disagreeing that they talk to family and teachers about difficult topics, 10% reported disagree, 30% had a response of neutral, 10% of the students disagreed, and 40% of the students reported that they definitely agreed that they talk to family members (question 2) and others (includes teachers) about difficult racial topics (question 5) .

Of the 40% of students who said that they felt comfortable talking about race to their teacher or parent, 20% expressed that they felt comfortable talking to their community teacher (guidance counselor), and the other 20% expressed that they participated in a racial affinity group, which allowed them to address difficult topics such as race with peers of color. From this analysis, students were having conversations about

race. Following are excerpts from some children's responses regarding racial discourse at home:

Maya: I do talk about race to other people as well. It's not just with my parents. I think a lot of the people in my family do talk about it. And it's a big thing that comes up in conversations and discussions.

Michael: Yes, because my mom watches the news a lot and I listen. They talk about Donald Trump and sometimes they say curses.

When Trevor was asked this questioned, his answers varied when his mom was present at the table in comparison to when she got up from the table to take a call. Here is our exchange (after mom left the table):

Researcher: Why are you neutral about talking to family or even teachers about difficult topics like race or maybe other things?

Trevor: The reason why I picked neutral is because my family say they're trying to help me, but sometimes I feel like they're in my business a lot and is like I need personal space.

This was interesting to hear Trevor's sentiments about privacy regarding communication with his family. Trevor made me further question if the physical presence of the parents influenced any of the responses. Only one parent had decided to sit out of the interview and wait outside, which was Michael's mom.

DAST Drawings and Race

All participants had drawing materials such as paper, pen, pencil, crayons, and markers to complete the drawing tasks portions of the study. All the materials were in the middle of the table when the participants were asked to complete their drawings, but none of the participants used any colored markers in their drawings. Perhaps the absence of

color could be due to my not mentioning that they could use the colored crayons and markers. However, no drawing could be clearly identified as not illustrating any representation of one particular race or ethnicity.

DAST drawings were initially used in 1966 and were later recreated by Chambers (1983). DAST drawings are used to examine standard images of scientists that children have (Chambers, 1983). DAST drawings have also been used to understand the age at which children develop their conceptions of science (Chambers, 1983). In this study, only two of the DAST drawings had the typical "Einstein" image of the scientist as a White male with wild hair wearing a lab coat and surrounded by symbols of research. This composite representation by some of the participants was similar to findings in previous research done with young children (Basu & Barton, 2007; Chambers, 1983; Mensah, 2011; Walls, 2012).

The analysis of the participants drawings was based on Chambers (1983) "scientist" indicators of a lab coat, eyeglasses, facial growth, symbols of research, symbols of knowledge, technology, and relevant captions. Only half of the drawings included scientists with lab coats. The lab coats in each of the drawings were white due to the absence of color and the white paper used for the drawings. The indicators of eyeglasses, facial growth, and technology were low for every participant, and sometimes they were not present at all. The majority of the drawings included symbols of research (80%) and symbols of knowledge (80%); see Table 5.1.

Table 4.1

DAST Indicators as by Each Child's Drawing

Participant	Lab Coat	Eyeglasses	Facial Growth	Symbols of Research	Symbols of Knowledge	Technology	Relevant Captions	Average
1	x	x		x	x		x	3.8
2				x	x		x	5.3
3	x		x	x	x		x	3.8
4								0
5				x	x			3.25
6	x			x	x		x	5.33
7				x	x			3.33
8	x			x	x			4.5
9				x	x	x		4.5
10	x							1

The average of each of the participant's indicators was taken, and it ranged from 1 to 5.33. The individual scores from each participant were coded and assigned a number, such as 1 for the presence of a lab coat. Then, the total score was summed and averaged to give a mean score (Chambers, 1983). The participants' grades were not included in the average indicators, as indicated in Chambers (1983) study. The average of the indicators ranged based on the amount of detail that each participated added (Figure 5.1)

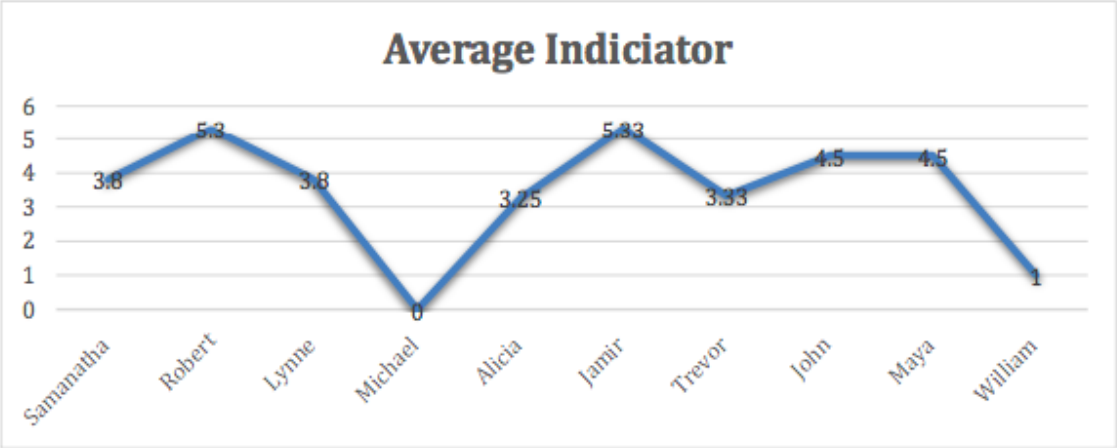

Figure 4.1. DAST average indicators.

The drawing analysis indicated the sentient regarding skin color (statement 4): "I feel comfortable talking about topics like skin color", In response, 10% answered definitely disagree, 10% disagree, 40% neutral, 20% agree, and 20% definitely agree. These percentages demonstrate the frequencies for each outcome. The measures of central tendency were also used as well to demonstrate mean, median, mode. However, since this study has small N=10, the test has limited power. Table 5.2 shows more detail for each measure.

According to Erduran and Dagher (2014), the nature of science allows students to understand the process of science, make informed decisions regarding science, appreciation of science, aware of scientific norms within the scientific community, and learn science content. Within all the drawings expect one, the students had illustrated that science is the act of "doing something" such as an activity. For example, in Samantha's DAST, she draws test tubes on a table and what appears to be a flask. She is also is holding a test tube. In her drawing she wrote that "the scientist is making an observation on test tubes" (Figure 5.2).

Table 4.2

Likert-scale Data for Items 1 to 8

Likert-scale data for Items 1 to 8 presented as percent agreement for each option

Item	Definitely disagree	Disagree	Neutral	Agree	Definitely agree
1. I enjoy learning about science	0	0	20	40	40
2. I feel like I can talk to my family about anything	0	0	30	30	40
3. I feel successful at school	10	0	40	30	20
4. I feel comfortable talking about skin color	10	10	40	20	20
5. I feel comfortable talking to others about race	10	10	30	10	40
6. I prefer friends who look differently than me	20	10	20	30	20
7. I prefer friends who look like me	10	20	50	20	0
8. In my opinion anyone can be a scientist	0	0	12.5	25	62.5

Note Item labels are condensed versions of the original scale items to conserve space.
Sample size = 10 respondents.

Another pattern that emerges from the drawings is that students learned that scientific ideas are formulated. In Robert's drawing (Figure 5.3), he used a diagram to demonstrate what appears be the water cycle. For his descriptions he discusses the process of how water causes plants to grow. Upon further analyses of each drawings, the drawings demonstrate that within science education, the nature of science influences student's abilities of learning and doing science (Duschl & Grandy, 2012).

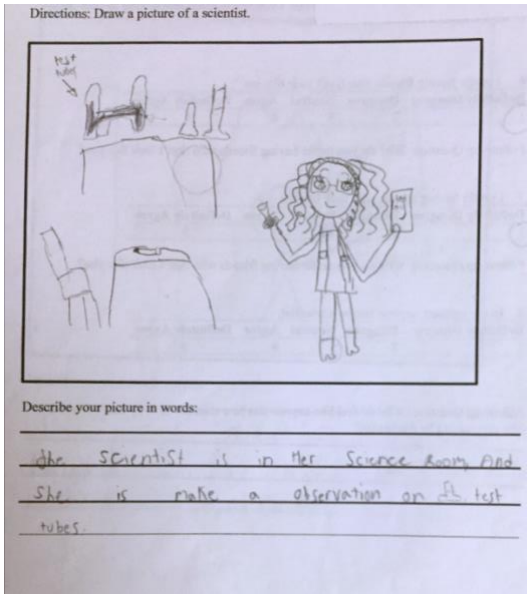

Figure 5.2. Samantha's DAST drawing.

Note: "The scientist is her science room and she is making an observation on test tubes."

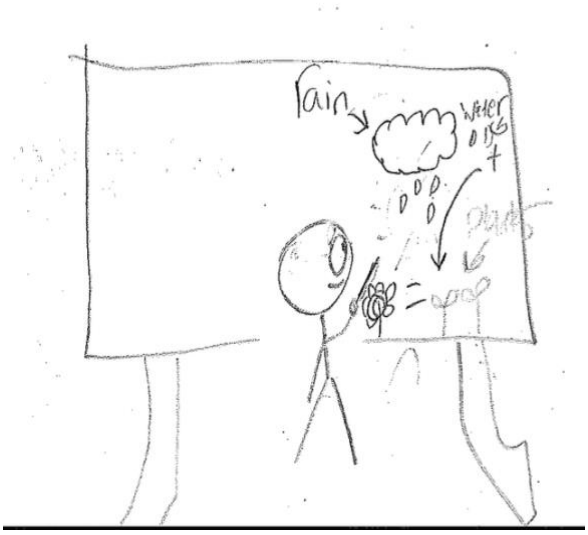

Figure 5.3. Robert's DAST drawing.

Note: "This is a scientist teaching when water hits tiny plants, then it turns to a fully-grown flower."

The students' images of science included their perceptions of how they see science (Walls, 2012). Based on the responses presented in their drawings, they believed that the scientist has specific qualities, including a lab coat, symbols of research, symbols of knowledge, and some captions. These qualities are aligned with Chambers' (1983) DAST factors. A common feature that students drew were lab coats; at least 50% of the students drew their scientist with lab coats. The presence of the lab coat is a stereotypical feature that children draw of the scientist (Basu & Barton, 2003; Chambers, 1983; Walls, 2012). The most prevalent feature in all the drawings was the presence of knowledge and research, which nine of the drawings showed this; as well as expressing the notion that scientists do something with their knowledge, such as conducting experiments or teaching (see Figure 5.4 and 5.5).

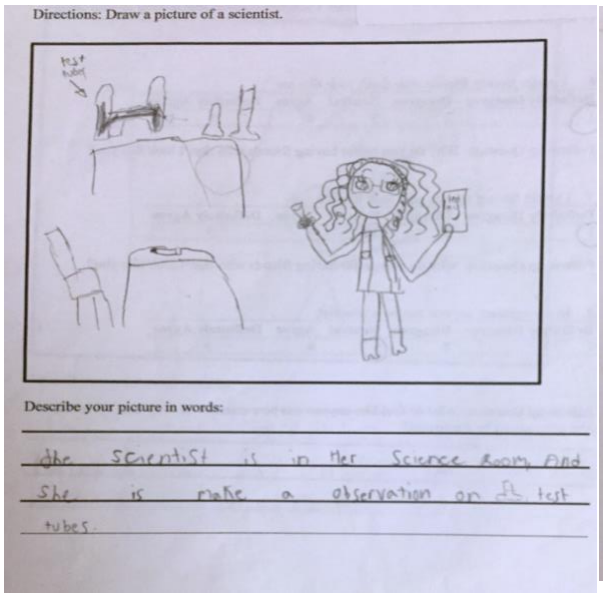

Figure 5.4. Samantha's DAST drawing.

Note: "The scientist is her science room and she is making an observation on test tubes."

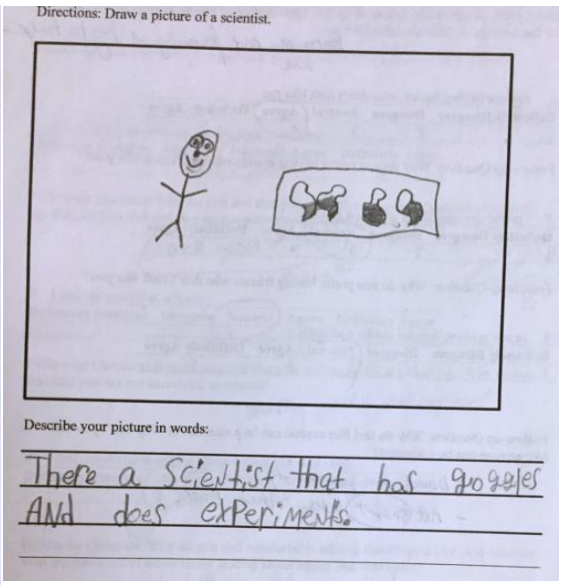

Figure 5.5. Trevor's DAST drawing.

Note: "There a scientist that has googles and does experiments."

Some of the descriptions of the drawings were not as clear. For example, Michael wrote that the scientist was going to work, but it was not clear what type of setting the male scientist was going to work in and what kind of work the scientist would do (Figure 5.8).

The identifiers of gender were present in some drawings. For example, two drawings presented scientists as females and six drawings clearly presented scientists as male. However, two of the students drew a scientist without gender. For example, Maya's and John's drawing were of a scientist without an assigned gender (See Figure 5.9 and Figure 5.10). In fact, John's scientist did not have a head! It could be implied that the drawing is male, as he states, the scientist has "a lab coat on (not a skirt)." Therefore, John made a point to distinguish his drawing of a lab coat from a skirt. The drawing of the scientist is headless, absence of skin color, and the absence of facia features and hair.

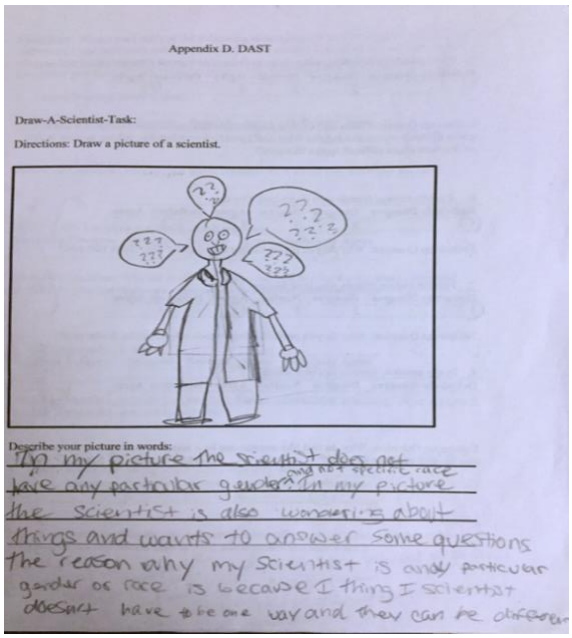

Figure 5.6. Maya's DAST drawing.

Note: "In my picture the scientist does not have any particular gender or specific race. The scientist is also wondering about things and wants to answer some questions. The reason why my scientist is not any particular gender or race because I think a scientist doesn't have to be one way. They can be different."

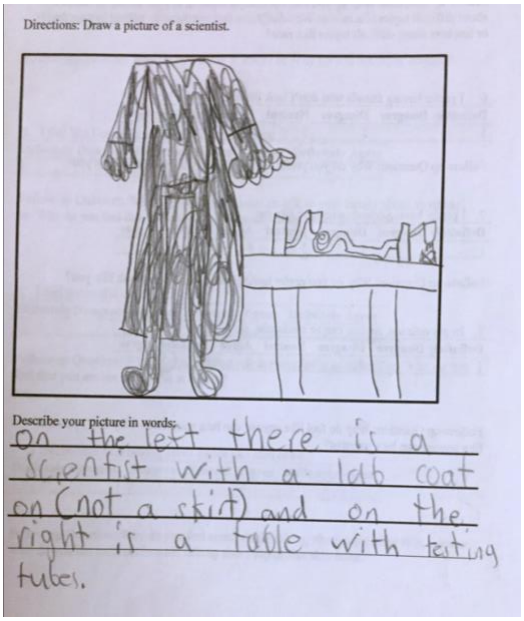

Figure 5.7. John's DAST drawing.

Note: "On the left there is a scientist with a lab coat on (not a skirt) and on the right is a table with testing tubes."

Figure 5.8. Michael's DAST drawing.
Note: "Going to work."

Further examining Maya's drawing suggests an awareness of gender identity. She wrote in her caption the following:

> In my picture, the scientist does not have any particular gender and no specific race. In my picture, the scientist is also wondering about the things and wants to answer some questions. The reason why my scientist is not a particular gender or race is because I think a scientist doesn't have to be one way and they can be different.

Both John's and Maya's drawings allow us to consider who children think for a discussion of the role of men and women in science as well as the gender stereotypes in science education and STEM fields (Hill, Corbett, & St. Rose, 2010; Kerkhoven, Russo, Land-Zandstra, Saxena, & Rodenburg, 2016). The next chapter provides the findings to the study on how the children viewed science through multiple perspectives or views of science.

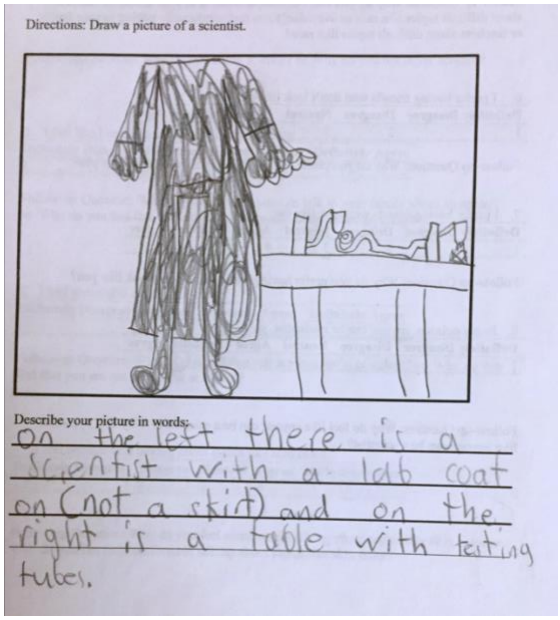

Figure 5.9. John's DAST drawing.

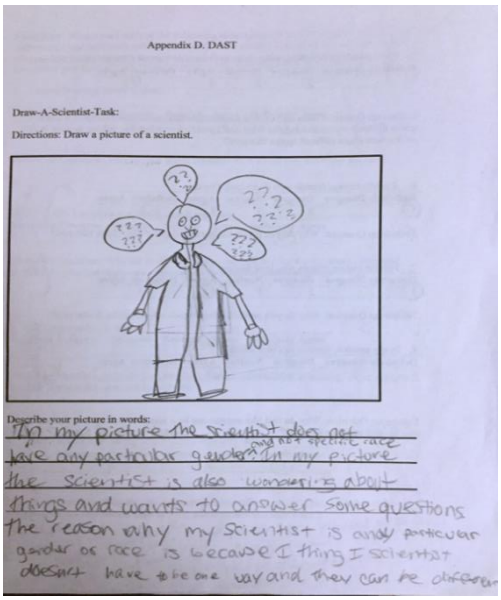

Figure 5.10. Maya's DAST drawing

Chapter V

FINDINGS

Views of Science

Students' views of science discussed in this section include how they see science in the world around them, what they are learning about science in school, and who they believe are scientists. These views are based upon the participants' engagement with photos, open-ended questions about the science they are learning, and their drawings. Having students engage in this type of inquiry allows for their schemas and prior knowledges to be activated (Duschl & Grandy, 2013; Lee & Songer, 2003). A student's prior knowledge can be organized to help them connect those prior understandings to new concepts (Basu & Barton, 2003; Dewey, 1902; Pintrick, Marx, & Boyle, 1993). When teachers use prior knowledge, students learn science by thinking in a different way to explain the natural world through the practices of science (Driver et al., 1994).

Science All Around Us

Many students shared that they experienced science at school and through connections outside of school. During our interview, Samantha expressed that she knows about "water cycles, plants, and magnets." Upon further examination of each transcript, it became clear that students' knowledge of science came from the natural world, and their knowledge covered many topics, such as matter, energy, how water affects the Earth, and chemistry. Students' responses to the photos (Appendix C), which were used to elicit

their thoughts about science indicated that, for them, science is nature, and nature is part of life cycle that affects plants and animals and involves the role of the sun. The majority of the students described the attributes of the photo in the photo elucidation session, that took place at the local university, with comments like, “I see leaves on the ground, falling from the trees.” Overall, the participants were able to describe the natural world by just examining the photos, and some of the students were able to use the photo as a base and then add what they had been learning in class or from the NYS fourth grade science exam. Robert, Maya, and Lynne had completed the NYS fourth grade science exam. In the excerpt from Lynne, she talked about her views and knowledge of science from the photos:

> Lisa: Okay, so the next thing that we’re going to do is I’m going to have you look at a series of photos and, for each photo, I’m going to ask you two questions. The first question will be, ‘What about this photo makes you think of science?’ and then my second question will be, ‘Where do you see science and this photo?’ You will have the opportunity to look at the photos on the Smartboard or you can look at the photo in front of you and we’ll go from there!
>
> Lynne: It makes me think about dying because of the leaves and how when they fall or when the leaves turn orange in the autumn. I see science in the trees because the leaves are falling off and usually in autumn/fall the leaves fall off the trees and turn orange. And then I also see science because when the leaves from trees fall, they can get decomposed by mushroom roots or fungi.

As the students encountered this portion of their interview with me, I wondered how much knowledge came from their school’s Science Week and their prior experience with their exam. Only three of the participants had taken the exam, and only two had taken it in the past year. Overall, the common understanding of science described by the

participants was an indicator that science was being taught in their classrooms and that there was a commitment to science education at Lincoln Elementary School. Before this research was conducted at the school, the school had a university science program initiative with students and teachers to increase STEM teaching. This initiative took place for three years and, the past year, the parent association led a Science Week focusing on plants and forest habitats.

Perceptions of the DESTIN Drawings

Variations of Chambers' (1983) study has been recreated by Mensah (2011) and Walls (2012). In comparison to the DAST (Chambers, 1983) procedure which focused on children's perceptions of science teachers, the DESTIN procedure (Mensah, 2011) was used to examine science identity and diversity issues with preservice teachers. The main objective of the DESTIN procedure was to promote discussion about science teaching due to elementary teachers not feeling confident in teaching science or having a science teacher identity (Gunning & Mensah, 2010). Another objective of this procedure was to construct new images of science teaching and understand the teachers' prior experiences with science (Mensah, 2011). The original procedure asked for post drawings (of ideal science teacher-not) of what the pre-service science teachers did not want to become, and this was done on the first day of class (Mensah, 2011). The post-drawing was completed at the end of the semester, and these sets of drawings illustrated what the pre-service teacher wanted to become a science teacher (Mensah, 2011).

For this study, the students were given a pre-drawing of the science teacher-ideal-not. This was to understand student's conceptions of what science teaching should

not look like and understand their conceptual thinking of science with young children. In using the DESTIN criteria, each drawing from the students assessed the position of teacher and/or student in the classroom environment, and the presence of science. The criterion was modified from Mensah's (2011) study, in which the open-ended task of drawing allowed the drawings to be examined from a variety of perspectives. The following modifications for this study did not address stereotypical images of scientists due to the students completing the DAST (Chambers, 1983) prior). Instead, the modified version addressed the position of the teacher and/or student in the classroom along with other factors such as engagement of both teacher and student, gender, and ethnicity. Similar to the DAST drawings (Chambers, 1983), there was no color within the drawings. Mensah's (2011) criterion addresses "alternative images" (p. 382) of science, the modified version chose to focus on this as well, but *the presence of science* was added. The classroom environment was also taken into consideration when analyzing the student's drawings as well. However, the drawings did not address diversity and identity like Mensah's (2011)'s study. This was not addressed in the analysis due to the analysis of the DAST (Chambers, 1983) drawings.

Table 5.1

Modified DESTIN Criteria

Criteria	
Position of Teacher/Student	Teacher in front/center, student face teacher directly, students surround teacher in a circle, alternative conceptions of learning (students not focused/paying attention), teacher not engaged, students not engaged,

Table 5.1 (cont'd).

	gender, ethnicity, age (teacher and student), knowledge of teacher, student knowledge, style of dress of teacher.
Classroom Environment	Presence of tables/desk, chairs, whiteboard/smart board, students standing, students sitting, science classroom (regular classroom), disorganization of classroom materials, chaotic environment, captions, boards, books.
Presence of Science/Alternative Images	Science materials (i.e., test tubes, formulas, etc.) Showing alternative conceptions or nontraditional to teaching science: science teaching outside classroom, students sitting on floor, student–student interactions, students as active learners, collaborative learning, mentions "student-centered" learning on drawings or in narrative; mentions the word "science" or "exploration" or "discovery" on drawings or in narrative, ask inquiry-based questions, mentions other related science terms, concepts, or content.

In all the drawings, each participant provided a clear indication of what science teaching should not look like. For the first criterion, teacher positioning, nine of the drawings indicated a teacher position in front of class or next to a group of students. The presence of the teacher tended to illustrate someone who stood over the kids. Additionally, four of those drawings indicated a disruptive learning environment and the teacher not being focused. The teachers' style of dress varied in each picture, with the teacher wearing a lab coat in only two of the drawings (Figure 5.12 and Figure 5.14).

Figure 5.1. Robert's DESTIN drawing.

Figure 5.2. Lynne's DAST drawing.

Identity and diversity factors used in the drawings were gender and racial/ethnic identity. The gender of the teacher was not always present and there was no indication of race in any of the drawings. However, in Samantha's drawing, the teacher and students were all women, as expressed in their long hair and facial features. I wondered if the teacher represented her because of the long hair and glasses that she was wearing when we met. Such a representation of the participant and the scientist as the same person was not consistent among every drawing from the participants. For example, Lynne's drawing reflected the typical "Einstein Scientist." Additionally, Maya, John, and Trevor drew teachers as simple figures without the presence of gender features.

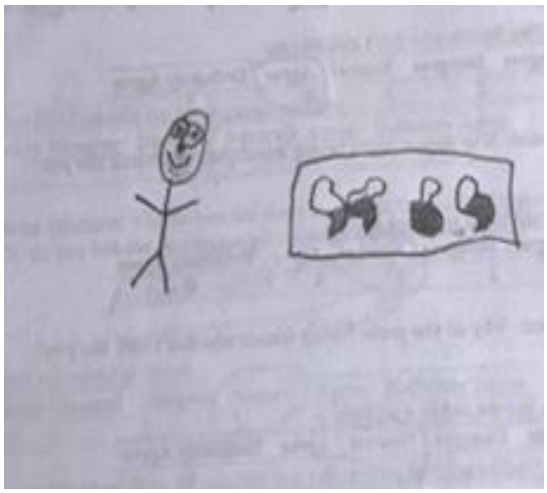

Figure 5.3. Trevor's DAST drawing.

Figure 5.4. Lynne's DESTIN drawing.

Addressing Criterion 2 (classroom environment), in 50% of the drawings was dialogue among teacher and student or just the teachers thinking to themselves. For example, John showed the teacher giving directions— "Okay kids! Come and get your projects!"—and the kids responded to shoving, with another kid expressing, "Hey, you broke my volcano." Lynne's drawing of a teacher was captioned with, "I give up" as another student seemed to be distraught, expressing "Whaaaaa." Samantha's drawing included dialogue as well. In her drawing, the teacher states, "You can do whatever experiment." The kids are saying "Boom," "Savage," "Yay," and "Omg" (Figure 5.16). Additionally, several of the drawings indicated the presence of chaos among the teacher and the children or the teacher and the materials. Only half of the drawings illustrated classroom materials such as a table, shelf, or chair.

Finally, images for Criterion 3 (the presence of science/alternative images of science) were only in half of the drawings. The presence of science was illustrated through drawing beakers or test tubes breaking and a substance falling to the floor or references to a "mad scientist" (Figure 5.15).

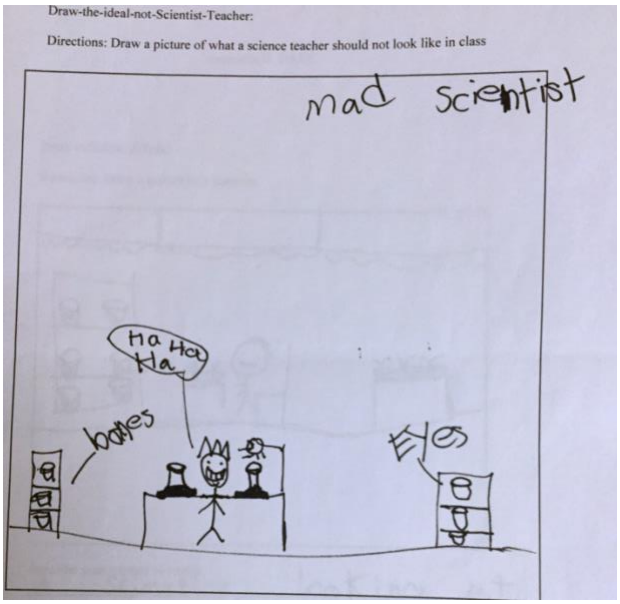

Figure 5.5. William's DESTIN drawings.

Note. "Mad Scientist… bones…Ha Ha."

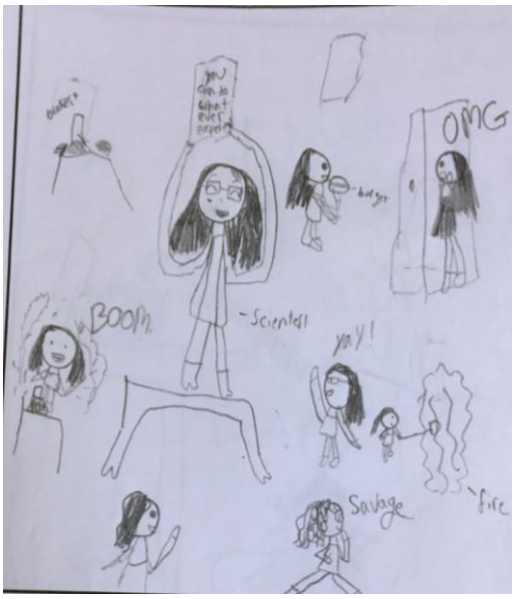

Figure 5 6. Samantha's DESTIN drawing.

Note. "Boom," "Savage," "fire," "OMG," "You can do anything you want."

Students and Science

To further address students' perceptions of science, a Likert survey was used to assess students' sentiments about science. The survey was used to gather students' perceptions about science as well. There were two statements on the survey to address participants' sentiments (statement 1: I enjoy learning about science) or the opinion that anyone can be a scientist (statement 8: In my opinion, anyone can be a scientist). Responses to statements 1 and 8 showed a largely positive agreement, with approximately eight or more of the respondents agreeing or strongly agreeing with each item. In further looking at the data in regard to students' responses to statement 8, 12.5% neutral, 25% agreed, and 62.5% of the students definitely agreed. This infers that the

majority of the students agree that anyone can be a scientist. This could be due to the partnership with the local university who places student teachers to provide science learning at Lincoln elementary school. The professor who facilitates this partnership has also provided professional development opportunities for teachers.

Another reason for students' responses could also be due to their teachers' science identity as well. Mensah (2011) suggest that is important for teachers to explore the curriculum and see new images of science teaching and the development of science teaching identity. I think the images of diverse scientists that students have exposure to provide multiple opportunities for students to see that science is for all and for them too.

Follow-up questions were asked to some of the participants to get more information about their responses to this statement 8. For example, when asked, "Why do you feel like anyone can be a scientist or why don't you feel like anyone can be scientist?" Trevor expressed that, "It's based on personality; what if you're not smart like the other kids?" Alicia stated, "If they work then they can be . . . that's with anything."

Families and Science

Parents' attitudes toward and involvement with science have been shown to be a predictor of their children's success (Kaya & Lundeen, 2010). However, if a parent is not comfortable with science, they tend to be more distanced from helping their children with science (Kaya & Lundeen, 2010). Family's experiences with and perceptions of science were analyzed using a 28-item Likert survey (see Table 5.4).

Table 5.2

Parent Likert-scale Data for Items 1 to 26

Item	DA	D	N	DA	A
1. I liked science in elementary school	0	0	0	80	20
2. I have always enjoyed science	0	0	0	40	60
3. I am able to help out with my child's homework	0	0	0	40	60
4. My involvement with homework has decreased	10	10	10	50	20
5. The homework signifies academic success	40	30	20	10	0
6. School family science event	0	0	10	30	60
7. I feel comfortable talking to my child's teacher	0	0	0	10	90
8. My child's school is welcoming to parents	0	0	0	10	90
9. Working parents are not as involved	40	10	10	30	10
10. School and Parent involvement	0	10	0	0	90
11. Science being taught more frequently	0	0	10	10	80
12. Interest in my child's science	0	0	10	50	40
13. I have volunteered at my child's school	0	0	0	50	50
14. Inequities among parents who work and don't	10	20	10	20	40
15. I am working parent	10	30	10	0	50
16. Hands on science is worthwhile	0	0	0	10	90
17. Enjoy science as an adult	0	0	0	50	50
18. Engagement in nature of science practices	0	0	0	20	80
19. Schools Welcome all families	0	0	0	0	100
20. My child enjoys science	0	10	20	40	30

Table 5.2 (cont'd)

21. Finding community science opportunities	0	10	20	20	50
22. Awareness of science community resources	10	20	10	50	10
23. Familiar with science curriculum	0	30	20	40	10
24. Teachers College Science Day	30	10	30	0	30
25. Difficult conversations regarding race	10	10	20	20	40
26. Ethnic background	0	0	0	14.3	85.7

Note. Item labels are condensed versions of the original scale items to conserve space. Sample size = 10 respondents.

The important aspects from the parent's Likert- survey were the parent's previous experience with science in elementary school and their enjoyment of science (statement 1 and statement 2). The responses to both statements showed positive agreement with all 10 parents agreeing or strongly agreeing to both statements. Connecting this, in the child-Likert survey, 8 of the participants had a positive agreement in liking science (statement 1). This finding suggests that parents' positive experiences with science then influence how their child finds enjoyment with science (Kaya & Lundeen, 2010).

There was also positive agreement with statements 11, 12, 16, 17, and 18 as well. All 10 parent participants had agreed or strongly agreed with being invested in their children's science learning. This sentiment has also been illustrated during my time at Lincoln elementary school as well. For example, it was the parent association of Lincoln that coordinated and developed a Science Week for students in K-5. This week mirrored the implementation of Science Day by the local university in previous years.

Another important aspect of this survey is that parents indicated that they were not familiar with the science curriculum being taught (statement 23), with only five participants agreeing that they know anything about the school's science curriculum. In hindsight, if parents were familiar with the curriculum it might help them in finding community resources for science learning. Only seven parents agreed or strongly agreed that they were familiar with science community resources.

School Community and Science

The school community appears to have taken great strides in forging relationships with the community to provide hands on science learning opportunities for students. This was reported to me by the principal. The community resources initiatives were also present during the Science Week at Lincoln elementary school with their BioBus partnership for the year. The implementation of Science Week in spring 2018 also integrated families and parents who had careers or jobs in science to help provide different learning experiences for the students. These different learning experiences for the students were hands-on and filled with inquiry. This was also shaped by local university partnership. During the school years 2013-2014, 2014-2015, and 2015-2016, the local university had created a STEM Day for students in K-5 with the coordination of the science education department and their preservice teachers. Parents were invited and encouraged to participate in activities taught by the preservice teachers in each elementary classroom in the school.

From kindergarten to fifth grade, there was a science presence inside and outside the classrooms. The bulletin boards outside each classroom highlighted the science learning that had been taken place through units of study, and each class had a section of

science learning illustrated in all of the classrooms as well. The teachers appeared to have created a culture of science learning in which learners were asked to keep a science notebook and provide reasoning for their thinking. This was demonstrated in the students' science notebooks and their posted work inside/outside the class.

For one particular classroom observation, I had the opportunity to observe a fifth-grade class during Science Week. The class met in the science room and was getting ready to learn about neuroscience. The teacher leading the science lesson was the grandparent of a child attending the school, and he had also been a neurosurgeon. He asked the class, "Hold your hands in front of you! Tap yourself on head, put your arm down." Then he asked the class the following question: "Did your arm move?" Some students called out, "You can't tell your brain to move!" Another student expressed that "The arm responds by brain commands and sends different commands throughout our body; it moves very fast." The engagement and enthusiasm of the fifth-grade class was apparent, and this was evident in the other classes during my observations as well.

It is important to note that many of the students in both fifth-grade classes had participated in the Lincoln Elementary Science Day when they were in first, second, and third grade. However, the partnership of the local university and Lincoln Elementary was not part of this study. It is discussed here to show the community science initiatives of the school and its families and the students' engagement in science overtime.

In the next chapter, major findings are discussed. The discussion addresses the role of racial identity for the students and their families, conversations about difficult topics such as race or skin tone. The major findings also discuss the students' views of

science. Many adults have such conflict due to personal discomfort and having colorblind ideologies regarding race (Milner, 2005; Milner & Laughter, 2015; Winkler, 2009).

Chapter VI

DISCUSSION OF MAJOR FINDINGS

The purpose of this study was to investigate how elementary children's racial identities influence their science learning. The study also investigated the students' understandings of their own racial identities and science identities. In addition, investigating parents' involvement of their child in science was studied. In this chapter, the major findings of the study are discussed.

Major Findings

In Chapter IV, the focus of race is addressed through the contexts of each participants' ethnicity, dialogue at school and at home, and the two sets of drawings they created. Initially, the ethnicity question was only taken for demographic purposes for both the participants and their families. However, upon further reflection, I decided to integrate that question into the study. For example, only five of the participants were able to answer the question, while the other five had deferred to their parent. The question that was asked was, "What is your ethnicity?" This question is not child friendly or inclusive in the dialogue that children may have with each other, which could explain why half of the participants were able to answer the question only with the support of a parent. It was likely the participants may not have had any exposure to the term.

In the classrooms, students had conversations about race. However, two participants (Maya and John) had weekly discussions regarding race due to the racial

affinity groups they participated in at their school. In addressing difficult topics such as skin color or race, there were inconsistencies of agreement amongst the participants and their families. This could be attributed to discomfort in addressing race with children in their families or developing racial socialization with one's family values where race is not discussed. However, most of the families who participated in the study were families of color, making it curious that parents were not discussing race with their children at home.

In Chapter V, emphasis is placed on participants' experiences with science and how they are able to see science from participating in the photo elicitation. The participants' perceptions of science were addressed using Chambers' (1983) DAST indicators. The most prevalent features of the participants' DAST drawings was the presence of knowledge (students using science words and phrase) and symbols of research (students drawing test tubes). For the DESTIN drawings (Mensah, 2011), the prompt was to draw a picture of what a science teacher should not look like in class. In these drawings, there was a teacher and classroom chaos. In both sets of drawings, the presence of gender was not illustrated, as well as the absence of skin tone and/or race in each participant's drawings, even though brown and black crayons and markers were available for the students to use.

The families' experiences with science was also taken into consideration. All the families reported positive agreement with science in elementary school and having science being taught to their children. In further examining the participants and the families experience with science, there was a positive association with the schools' commitment to science and the support of the local university to promote science in the

school. The positive association could be attributed to the timing of the interviews with the participants and their families, as some of them took place during Science Week.

The Role of Racial Identity Development

Many adults have conflicting views about discussing race with their children at home and at school. Many adults have conflict due to personal discomfort and having colorblind ideologies regarding race (Milner, 2005; Milner & Laughter, 2015; Winkler, 2009). Some adults have expressed that children are "too young" (Winkler, 2009, p. 1) or that if a child has an idea about racial bias, it means that "someone must have said that at home" (p. 1). However, research has shown that children develop awareness of race and racial bias from a very young age (Price-Dennis, Holmes, & Smith, 2016; Rowley, Burchinal, Roberts, & Zeisel, 2008; Sellers & Shelton, 2003; Walls, 2017; Winkler, 2009). This was illustrated by all 10 participants who were in this study who were ages 8-10 years old.

In this study, the context of race and racial identity was apparent for all 10 participants. Each participant had experience with the social context of race and had expressed feelings about race through dialogue at home and/or at school. For many of the participants, there was a sense of discomfort addressing difficult topics such as race and skin color. For example, in response to Item 4, only five of the participants showed agreement about addressing this topic, while two disagreed, and three expressed a neutral view. These percentages were consistent for Item 5 which asked, "I feel comfortable talking to others about race." Participants were asked follow-up questions regarding their sentiments. They expressed that conversations about race or skin tone were rude or that they could hurt someone feelings.

However, two participants (Maya and John) expressed experience in engaging in difficult conversations about race because of their participation with a racial affinity group at their school. This prior experience with racial dialogue may have increased these two participants' confidence. What was interesting about Maya's interview is that she had also included that she was a "person of color." None of the other children had described themselves in this way. Perhaps they did not because I only asked them to describe themselves without any clarification of what that meant. In listening to Maya's description, she appeared to be comfortable and have confidence in describing herself as a racial being. I wonder what made Maya find comfort in describing herself as a racial being. Perhaps it could be due to her mother expressing that she feels very comfortable in having discussions about race and other difficult topics with her daughter. I was not able to ask Maya or her mom a follow-up question. It would have been great to have an in-depth conversation with them about their family socialization regarding identity development with race and Maya's racial identity.

The other student participants did not mention themselves as racial beings which could be due to the context of the question. For example, could the question imply one's physical appearance or intrinsic characteristics in describing oneself or a combination of both? Due to this lack of clarity that I did not provide, these children's family socialization in regard to race might stem from their families not seeing themselves as racial beings. The possible implications made me question the role of racial discourse within families. For example, parents were also asked about their comfort about racial dialogue.

Many of the student participants expressed that, in school, they had discussed race through the lens of slavery and the Civil Rights Movement and in conversations about Donald Trump. Perhaps more exposure to multicultural literature aimed at engaging in topics of race will help support children's understanding of the world and themselves. According to Price-Dennis et al. (2016), making literature the focal point for our children's understandings aids them in critical inquiry. Children already engage in inquiry about the world around them due to their own experiences within their community of practice (Jackson, 2012; Lave & Wegner, 1991).

Affinity Groups in Elementary Schools

From the study, both Maya and John and mentioned that both participated in a racial affinity group at their independent school located on the upper west side. Both Maya and John expressed their experience within this group and their comfort in addressing difficult topics such as race and skin tone. To further define the forum of a racial affinity group, Tauriac, Kim, Sarinana, Tawa, and Kahn (2013) state, "Affinity groups (or "caucus groups") are meetings in which participants gather based on a particular social identity to discuss related personal experiences" (p. 24). Affinity groups have formed to engage participants that share similar social status, common goals, or race/ethnicity (Tauriac et al., 2013). The goal for affinity groups is for participants to receive validation for their experience and discuss their feelings. According to Tauriac et al (2013), "Participants can receive validation from same-race peers and might "test out" ideas or previously unarticulated feelings about other groups before bringing them up directly to outgroup members" (p. 245).

The commonality in-group context that affinity groups offer, benefits all students including those in public school settings. The experience of a racial affinity group would allow children to share their challenges and receive validation for their feelings. It would also benefit a child's social-emotional learning and their racial identity development as well.

For the other participants, they attend a school that is more racially diverse, which was interesting that race was not often discussed in the classroom. The absence of racial dialogue in their classrooms may be due to a larger political context of race. For example, two participants had expressed that "Trump" was mentioned in conversations in their class and at home. Perhaps due to this political context of the presidency has left feelings of discomfort or sensitivity in not talking about race in school, especially because of the large diversity and immigrant families in NYC.

Another question that this study examined was the role of family socialization and dialogue involving topics like race and skin tone. Dialogue about race in a family is referred to as racial socialization, or the process by which parents express both implicit and explicit views of the social context of race (Tang, McLoyd, & Hallman, 2016). According to Nelson, Syed, Tran, Hu, and Lee (2018) racial socialization also includes two types of processes that the family undertakes: preparation for bias and mistrust. Children often internalize their ideas of race due to their parents' own beliefs and messages about race, heritage, or cultural traditions (Nelson et al., 2018; Tang et al., 2016). While this study did not directly address racial socialization among the participants and their families, its influence was implicit in the students' and their families' comfort or discomfort with addressing the difficult topics of race and/or skin

tone. The students' racial identities did not seem to inhibit their experiences with science and/or their science identity. This is discussed later.

Children's Development of their own Racial Identity Development

From this study, it can be perceived that many of the children are still growing in their racial identity development in how they view themselves and others from a racial lens. Their awareness of racial identity will continue to develop as they get older and have different experiences within their community, home, and school. The children who participated in this study ranged from the ages of 8 to 10 years. This age bracket is still young for children to fully develop and to be able to talk about being racial beings in comparison to older adolescents. Adolescents' experiences and their ability to engage in dialogue regarding race looks different than it does with young children because they have had time to develop their sense of self. For example, in having discussions with the children about engaging in difficult conversations about race or other difficult topics, many of the children reported that it was rude or talking about race would hurt others' feelings. If the children were adolescents, they could perhaps have a different response. Jackson (2012) suggests that young children engage in inquiry about the world due to their exposure and understanding they get from school. In regard to children making assumptions about their own racial identity, this is not fully present (Jackson, 2012).

However, in this study, Maya was the only participant who had a strong sense of racial identity development in comparison to other participants by her stating she "was a person of color". Maya's sense of racial development aligns with Wijeyesinghe's (2012) definition of racial identity, which states that racial identity is a "racial category or categories that an individual uses to name him or herself" and these are "based on factors

including racial ethnicity, physical appearance, early socialization, recent or past personal experiences, and a sense of a shared experience with members of a particular group" (p. 82). The other participants in the study were not able to do this, which is not a deficit. It mainly has to do with the developmental stage of the child and their family's socialization regarding racial identity.

Views of Science

When young children learn science, they are able to see the world from another lens in comparison to how a writer, reader, or mathematician would see the world. Looking at the world from a science perspective allows children to make observations and inquiries, relate their prior experiences to what they have seen, and state claims. It was my hope that my research questions sought to understand how students' access to learning science was related to their understanding of race and/or ethnicity. When students were asked what they know about science, each participant was able to engage in dialogue in different ways about science. For example, students had expressed that they knew about "experiments," "sound energy," "how water affects earth," and the "solar system." For the students in this investigation, learning science and engaging in discourse with scientific practices and knowledge of concepts was being done, and this was also apparent during my classroom observations. The students had positive agreement with statement 1, with 80% agreeing that they enjoyed learning science.

Additionally, race and views of science were examined in the two drawing tasks completed by each of the participants. In the study, students were asked to complete the DAST (Chambers, 1983) and the DESTIN (Mensah, 2011) protocols. One of the study's goals was to analyze the drawings using the indicators form Chambers (1983) to identify

the students' perceptions of science and their drawings having more of the "Einstein" features of a scientist. The conceptualized view of a scientist varied based on children's own experiences and stereotypical images of a scientist. For example, only 20% of the drawings had the typical "Einstein" drawing. This coincides with previous drawings with young children and pre-service teachers (Basu & Barton, 2007; Chambers, 1983; Mensah, 2011; Walls, 2012). In regard to the DESTIN composite drawings, the children were able to identify what science teaching was not, and they drew in detail the chaos of what that could like with a teacher and the science classroom environment.

In this study, however, I want to draw attention to gender identity and absence of gender in the drawings in both the DAST and DESTIN drawings. For example, two of the drawings were of females, six were of males, and two could be considered non-gender conformed. Based on these drawings, one can suggest a positive relation between the drawn image and the individuals' self-image. For example, in both the DAST and DESTIN drawings Samantha drew a girl scientist for both drawings. This was also consistent for Robert, who drew a male scientist for both his DAST and DESTIN Drawings as well. However, Lynne's image (see Figure 5.8) for both her DAST and DESTIN drawing had a stereotypical image of a white male scientist. Research has shown that this stereotypical version of scientists drawn by children often include images of White males (Barton & Basu, 2007; Chambers, 1983; Farland-Smith et al., 2017; Walls, 2012). According to Kerkhoven et al. (2016), stereotypical images of white males convey that science is for boys.

However, in this study the students had varying perspectives of images of the scientist that did not convey that science is for boys. For example, Samantha's images

(Figure 5. 1 and Figure 5.9) for the both DAST and DESTIN drawings had a girl scientist. Another example of alternative conception of images of scientist was apparent in both Maya's and John's drawings (Figures 5.5 and Figure 5.6). Both of their drawings were non-gendered images of a scientist, which could suggest a positive view that anyone can be a scientist, but this could also imply a colorblind ideology that science is not for those of color.

As social and cultural factors impact science identity and science literacy, they also impact how stereotypes develop; which, in turn, creates gender bias in science education (Kerkhoven et al., 2016). This indicates that it is important for teachers to promote a gender balance along with critical pedagogies for children to see the intersection of visuality, race, gender, and science (Gardner, 2016; Kerkhoven et al., 2016). Educators addressing this balance allow girls to see that women can also be scientists (Kerkhoven et al., 2016).

Examining young children's experiences with science is central to science identity development because it provides more insight into science literacy, how knowledge and agency in science are constructed, and interest in pursuing careers in science. The majority of the students who participated in this study expressed an understanding of science knowledge given their experience in school. Students also expressed an understanding of how science is all around us from their observations inside and outside the classroom. In further analyzing the students' understandings and views of science, there are connections to identity and agency within science education. This could be understood as the culture of power (Delpit, 2006) that students are allowed to participate

in science based on how their identity of science was constructed in their schooling and family socialization, which helps to facilitate the development of a science identity.

Having a strong science identity as a child in grades 3-5 situated in an urban setting demonstrates the commitment of not just the teacher, but the school, family, and the local university partnership as well. This suggests that a strong science identity extends beyond the classroom and is supported by the community. The interconnections among teacher, school, family, and community refer to Lave and Wegner's (1991) community of practice in which members serve as "full participants." The notion of "full participants" that Lave, and Wegner referred to describes how one is able to master knowledge and skills through the practices of a community. From this study, one can infer that the students and their family's experiences within science helped to shape their science identity. Another assumption that could be inferred is the possibility of having a positive school science experience that could influence one's science identity.

Examining students' perceptions of science provides valuable insight into teaching science to students from diverse backgrounds and addressing students' stereotypes in science learning (Brown, 2004; Chambers, 1983; Mensah, 2011; Walls, 2012). Further, with an analysis of the students' drawings, learning as it pertains to science, such as how both the students and teachers are positioned in the DAST and DESTIN drawings, is seen. A question that could be considered in this study is, "How are the students positioned when learning science in their own classroom spaces?" For example, some of the students drew the teacher as the center when conducting science or the center amongst students. How are the students positioned as learners? As problem solvers? How do they engage scientific inquiry? (Kim, 2018).

There was 80% agreement that each participant enjoyed learning science. However, I wonder how this enjoyment will transfer as the students transition to middle school. Research has shown that students' interest in science from elementary school to middle school declines (Carlone, Scott, & Lowder, 2014). Some of the participants from this study transitioned to middle school this current school year.

To investigate parents' involvement with their child's schooling, interestingly, analysis from the parent survey demonstrated positive agreement with 90%-100% of the respondents agreeing or strongly agreeing with enjoying science in school (statement 4) and having science taught more frequently (statement 12). This positive agreement was also shown in the students' responses to statement 1 and statement 8. The positive responses from this survey indicate how sentiments and/or experiences from families influence their children's experiences with science. These positive responses are similar to Kaya and Lundeen's (2010) study about families and interactions with science learning, as well as with Johnson and Hull's (2014) study that examined the parents' involvement in science learning for grades 3-8.

Intersectionality within Science

Intersectionality challenges us to think about our social identities and how we are interconnected with race, gender, class, ethnicity, and age (Wijeyesinghe & Jackson, 2001). Analysis in an intersectionality framework demonstrates that race and racism do not exist without gender and therefore gender does not exist outside of racism (Mensah, 2019). This position of intersectionality highlights the symbolic importance of experiences and relationships (May, 2015; Mensah, 2019a). Within the field of science education, discussions of racial identity are nonexistent in teaching young children

(Mensah, 2019a). However, this is counterproductive because “science education is a marginalized content area in elementary school settings” (Berg & Mensah, 2014).

Within this study, intersectionality was not a focus for who the children were as individuals, but intersectionality for the children was connected within race and science. For example, within all the science drawings race was absent. Yet the majority of the children drew their scientist “doing science”. Even in our clinical interviews, the children had spoken about their experiences with science at school. However, I wondered did the children still hold onto the notion that science is not for those who look like them or those who are not of color? The lack of race within the drawing assessments was present for all children. Which led me to think about the growth development of racial awareness for children. Only two of the participants had more of a developed racial awareness, which were Lynne and Maya. There awareness opens us further implications to family socialization regarding race or their experiences. According to Mensah (2019a), “Conceptualizing race as a social construct can have early implications for young children who are treated differently because of their race. With race and racism as defining factors in society, even the youngest of children are socialized and influenced by its power” (p. 15). For these two young girls, in particular, they had already gone through different treatment based on race. Lynne reported she was bi-racial, and people would ask her who or what she is, racially. Maya also reported that she attends a racial affinity group at her private school.

Without sharing the voices of these students, there would still be an unawareness of racial identity development impacts young children. There is no age limit as when we can discuss conversations that pertain to racial identity development of young children.

Learning about the children in this study further provides me with implications on creating a culturally responsive curriculum with science education. In the final chapter, the Conclusion, Implications, and ideas for Future Research are presented.

Chapter VII

CONCLUSION, IMPLICATIONS & FUTURE RESEARCH

The findings across both chapters 4 and 5 indicate the ways in which family and school are situated in one's community of practice. The influences of both family and school contribute to one's identity and how the students see the world from a racial and science lens. These factors also influence how and what one learns about race and science through socio-cultural practices as well as how these socio-cultural practices are forever changing due to the situations in which one is located, such as in the context and role of school versus home and vice versa. This also illustrates the diverse nature of identities and how students are able to maintain dual citizenship in multiple spaces or social structures (Brown, 2004; Kao, 2000). In analyzing the social structures from this study, the themes of school, community, and family intersect for each students' racial and science identities. I also think these factors also influence how students see the world and how they engaged with science.

The findings of the study contribute to an ongoing discussion in science education of fostering a classroom community where identity is examined and integrated into one's learning. This study provides valuable insight on children's and adolescents' development of science identity based on their communities of practice and the culture of school science that is supported in the school. This study also leads us to further explore the roles in which a community of practice is valuable for one's development as a learner and continues to provide agency.

From this study, there were connections to the parent's positive experiences with science and their children's positive experiences, though school had a strong influence as well. Family socialization in regard to race and conversations about race and skin color also influenced students' sentiments and their own comfort in engaging in topics like this. For example, only Maya and John were comfortable in expressing how race and topics of skin color were also addressed at school and home. However, Maya was the only participant who saw herself as a racial being and referred to herself as a "person of color." Regarding the comfort in having difficult conversations that pertain to race or skin color, many of the children had disagreed; this was similar to the parent's finding as well. If a parent was able to engage in race conversation, so were the children and vice versa. In this study, many of the participants were children of color. Yet the majority of the parents had not engaged in difficult conversations about race with their child.

Additionally, there was no relationship to the students' race/racial identities and how race could impact their science identity or their learning of science. This may be due to the students' positive science learning experiences due to the partnership with the local university. The role of the local university's science learning at the school provided cultural and meaningful experiences for the children, teachers, and families. Each lesson included children's prior knowledge of STEM, use of literacy integrations within STEM, and culturally relevant pedagogies. Due to these factors, the students felt comfortable in doing science and seeing science all around them. From their school experience, science was for all. For Maya and John who attended a private school, science learning was something they had as well.

Implications

There are several implications for this study. They are addressed through the curriculum, or what is taught about racial identity in elementary schools; teacher education and teacher professional development; and families and discussions of race with young children.

Implications for Young Children and Racial Identity

To consider the role of curriculum creation in student learning, it lends itself to understanding the role of race in regard to representation and learning (Gardner, 2016; Leonardo & Grubb, 2014). In thinking about the children that we teach, it is important for us to examine how race and visuality intersect. For example, Souto-Manning, llrena, Martell, Maguire, and Boardman (2018) use the metaphor, "where there are no mirrors and everything is a window, there can be socioemotional and academic implications" (p. 18). This metaphor illustrates the importance of racial identity development in schools for young children. This notion of mirrors illustrates the importance of the identity of our young people. Also, from a pedagogical perspective, the knowledge plays a vital role in how students construct meaning and learning. For student learning, culture should not be separate but rather build upon that learning (Jordan, 2010).

For the students who participated in this study, people of color are mentioned when they are learning social studies. For example, more than one student reported learning about slavery and the Civil Rights Movement as discussing race in the classroom. This learning provides a historical background of race in America by discussing slavery and the Civil Rights Movements. It does not provide students with a current context of discussing race in the classroom as it pertains today. Students need

time to learn, reflect and challenge oppressions that have been set forth by race (Leonardo & Grubb, 2014).

Providing opportunities to teach children about racial identity will meet children where they are about racial identity (Goodman & Jackson, 2012). By addressing where children are on this journey it allows them to understand who and what they are. Goodman and Jackson (2012) suggest an intersectional approach in teaching racial identity which provides a single focused approach to a multidimensional approach. For example, if providing students with a race center approach, you want students to explore how race is socially constructed and how one decides to racially identify with a particular group (Goodman & Jackson, 2012).

Given the evolving nature of teaching and classroom demographics, we must examine the racial identity development of the children we teach (Ritchie & Smith, 2016; Smith & Darfler, 2012). This examination is important for the nature of science as well (Smith & Darfler, 2012; Walls, 2012). For example, in critically examining the results of this study, the majority of the children did not see themselves as racial beings. The students also associated topics of skin color with discomfort. If the children had exposure to racial identity, and discussions about their racial identity, perhaps there could have been more comfort in knowing that it is okay to be a person of color or to even be white.

Student Learning And Knowledge Construction

According to Dewey (1901), we should "abandon the notion of subject-matter as something fixed and ready made in itself, outside the child's experience as also something hard and fast; see it as something fluent, embryonic, vital" (p. 189). Looking at children's experience from Dewey's perspective allows us to appreciate the identity

formation of children and challenges us to provide children with a variety of content exposure. Identity development helps us to understand how young children develop as individuals and learners in a world that is often familiar to them and in ways that are different from their experience. As we think about how children are situated in the context of their daily lives within school and home, many things happen as they learn to navigate their interests, dislikes, creations of friendships, etc. Identity formation provides insight into who children are holistically, and this study aimed to capture the interrelationship of race and other social identities (Goodman & Jackson, 2012). This interrelationship demonstrated the importance of intersectionality and how one navigates duality amongst different identities. In further examining this intersectionality, it is important to understand how students construct knowledge in all facets of their lives.

From cultural and pedagogical perspectives, the notion of knowledge plays a vital role in how students construct meaning. This notion of knowledge helps provide a framework for multicultural education and a variety of strategies to help support diverse learners (Nieto, 2007). This approach to teaching involves structural change in content rather than the process (Nieto, 2007). Approaches to multicultural education focus on higher order thinking to help form knowledge and, from this approach to teaching, students are able to reflect on their own personal ideas (Banks, 1994). Engaging in learning from a multicultural education and social justice framework further empowers students to look at the world from multiple perspectives and challenge master narratives.

When teaching children from diverse backgrounds, we must ask if our students see themselves reflected in their learning. From the results of this study, it can be inferred that the students did see themselves. However, I suggest that more opportunities could be

given to show how visuality connects with race and/or science. For example, Gardner (2016) examined students' perceptions of skin tone and beauty from a variety of picture books depicting Sojourner Truth. The children's responses to the pictures raised critical questions about how social structures like race can influence and confound children's responses (Gardner, 2016). Based on the students' responses in the present study, it appears that there is a need to engage in critical pedagogies of literacy in race and science. Engaging students in critical literacy can create an open dialogue for students and teachers (Price-Dennis et al., 2016; Souto-Manning et al., 2018). Students need reassuring that it is okay to address difficult topics that examine race, gender, and identity. Students can do this type of work with the help of teachers, providing them with different critical responses and accountable talk strategies. These types of strategies can be used with students in K-5. For example, in the book *Chocolate Me* by Taye Diggs, which addresses race and skin tone, a character relates, "When we'd play, they'd say, look where your skin begins! It's brown like dirt. Does it hurt to wash off?" (p. 3). Students could share how the character is feeling, how they would feel, why this happens, and what is the perception that people have of dark skin.

Different critical pedagogies can also be used to address students' perceptions of the characteristics of a scientist. More research needs to be done related to positionality with science and cultural norms. A question to consider is how children define "science," especially given that they already have stereotypes of who scientists are and not. Other questions that could be considered for children's positionality as they are learning science.

Furthermore, Tenorio (2018) suggested that in order for young children to be more accepting of differences and similarities, they can use “me pockets,” which allow them to reflect on the cultural and diversity of their families; “partner questions” to help them listen to each other’s perspectives; and “skin color and science,” or “let's’ talk about skin color,” in which the teacher poses a question about whether anyone has ever heard someone say something insensitive about someone’s skin color (p. 354).

For further addressing identity development through the lens of science in their classrooms, Smith and Darfler (2012) suggested that,

> Identity work is about establishing instructional conditions that motivate and empower students: identifying desired learning outcomes, promoting students’ autonomy and competence, teaching and reinforcing self-regulation behaviors, and employing cooperative learning task that encourage students to work with and learn from one another. (p. 362)

Smith and Darfler’s perspective illustrate how social and cultural factors impact scientific literacy for our young children. Therefore, we need to have targeted science instruction by which our children are able to engage in this type of work (Walls, 2012).

Implications Teacher Education and Professional Development

Both preservice and in-service teachers need to have the opportunity to engage in learning and PD opportunities to help them address racial inequities within education. Having conversations of this nature helps teachers examine how race and racism influence educational equity for all and limit academic success (Ladson-Billings, 1994; Mensah, 2019b).

Supporting students in their dialogue about race starts with teacher education programs and professional development (Mensah, 2019b). From my findings, there needs to be more preparation of preservice teachers and professional development opportunities

for novice and veteran teachers. Even parent workshops address teaching about racial identity can be helpful. Teacher education programs and schools do not provide opportunities to address race (Mensah, 2019 a,b). Mainly, for teachers and the conversations they have about race in education to teach students of color, these conversations should address the influences of race and racism in educational equity (Mensah, 2019b).

Mensah (2011, 2012, 2016, 2019b; Moore, 2007) has utilized many approaches to address diversity and equity in science teacher education and teacher professional development. A professional development approach that teachers could benefit from is book club discussions that Mensah has used in preservice teacher education. This provides a collaborative learning experience to confront assumptions regarding race and positionality (Mensah, 2019a). Another approach is to have teachers engage in racial literacies for themselves and the students that they teach. Racial literacy is "the ability to discuss the implications of race and American racism in edifying and constructive ways" (Sealy-Ruiz, 2011, p. 25).

Racial literacy can support an open dialogue for students and teachers (Price-Dennis et al., 2016; Souto-Manning et al., 2018). Students need reassuring that it is okay to address difficult topics that examine race, gender, and identity. Students can do this type of work with the help of teachers, providing them with different critical responses and accountable talk strategies during read-alouds. This critical approach could also be addressed in the context of curriculum as well; this is referred to as having an anti-racist curriculum. An anti-racist curriculum provides opportunities for a social justice approach in how students see multiple perspectives and act as agents of change, such as learning

about heroes and holidays or examining multiple perspectives in history (Banks & Banks, 2010; Mensah, 2019b).

In doing this work of teacher education and teacher professional development, Mensah (2013, 2019b) suggest that schools must help teachers think about the diversity of their students and the implications of race and racism. If teachers are able to achieve this understanding, then they would be able to view students from an affirming lens and acknowledge the plurality of their students (Villegas & Lucas, 2002). However, if teachers are not able to do this type of work, then they will continue to look at race and racism from a deficit perspective (Mensah, 2013; Villegas & Lucas, 2002).

Implications for My Teaching Practice

My early experiences with race and science education has shaped my teaching practices as a Black women science teacher. It has allowed me to address educational inequities within the field of science education and in my teaching practices. Because of my race and gender and how they both intersect with each another, I see the importance of intersectionality in understanding self and science. In embracing my intersectionality with race and gender within science, it has allowed me to answer the following questions: "who can do science, who can teach science, who is a scientist, who is a science teacher, and what is considered science knowledge to be taught and taught to whom?" (Mensah, 2019a, p. 38). I can do science, I am science, and the nature of science skills is what should be taught to all children. Every child needs to see themselves as a scientist just like the kids in this study.

Had I not been on this educational journey and confronting my experiences with race, I would not be able to take the stance on equity for all within science education.

According to Mensah, “When race and racism intersect with gender and science, and other social markers (Mensah, 2009b), achieving educational equity within content-specific domains of teacher education come into play not only for who teachers are (their identity) but also for what they teach (the content)” (Mensah, 2019a, p. 37). For my teaching practices this year, I have been creating an integrated STEAM curriculum to address climate change in grade 4. I have also been addressing the importance of being an authentic scientist in terms of embracing my identity. I have been doing this for all my classes because they often comment on my shoes and manicured nails. I always express that as a scientist it is important to be who you are and bring that with you every day, cause I am. Though my students are different people, we are all different, we share similar experiences as learners.

It is important for teachers to reflect on their own positionality in relation to different social markers and race (Leonardo & Grubb, 2014; Mensah, 2016). We need to continuously examine these roles for our own teaching practices and reflect on them in order for us to become more aware as practitioners in our field. Regardless of our race and/or ethnicities, educators bring their racial identities with them. Leonardo and Grubb (2014) stated that, “Race is not just something we make, but something that makes us” (p. 147). This notion coincides with the children that we teach as well. Engaging in the practice of reflection on race allows all educators to understand that this type of work is a process and that race awareness has difficulties (Leonardo & Grubb, 2014). These difficulties are not just faced by educators but also by students, which illustrates the importance of educators engaging in dialogue regarding critical race pedagogies for

themselves and for their learners. Leonardo and Grubb also suggested that we examine racial awareness from the following perspective:

> If you think you got it, then you ain't got it. Race awareness is a process of becoming rather than being, a matter of practice rather than an identity one takes on. In other words, race awareness is what you do, not what you are. (p. 148)

In becoming aware, educators have to allow themselves to challenge their preconceived notions of the world (including their values) and allow for the realities of their students (Delpit, 2006). Teachers do this work, first, by understanding their own power through asking questions, raising questions about their curriculum, raising questions about discrimination from marginalized groups, listening, and hearing what is said (Delpit, 2016). This approach is not just for novice teachers, but also for pre-service teachers. As teachers, we have to continuously reflect on and examine our positionality (Mensah, 2016). Watson (2018) stated that "we need teachers who will examine themselves as racial beings who teach other racial beings and figure out what they are doing wrong and what they are doing right" (p. 185). This sentiment holds true for all teachers, but one of the challenges that we face is recognizing when we are wrong and reflecting on what we can do better.

After doing this work for ourselves as teachers, the next step is to transfer an application of it into our pedagogical practices in our classrooms. Goodman and Jackson (2012) suggested an intersectional approach to teaching about racial identity that includes "a race-centered, single identity focus; a race-centered limited intersectional focus; a race-centered intersectional focus; and a full intersectional focus" (p. 219). The majority of the objectives and activities that relate to these pedagogical practices are geared towards older students, such as those in middle and secondary education. However, some

of the activities—such as having children explore their own culture or another's culture, listening to the stories of others, and reading historical accounts—can be scaffolded to use with younger children (Goodman & Jackson, 2012). All of the suggested activities provide an entry point for examining multiple perspectives, critical literacy, and social justice education.

Implications for Elementary Science Education

In providing support to teachers around science education, teachers need to examine their own positional identity. This helps teachers to challenge their assumptions (Mensah, 2012, 2016, 2019a). Additionally, in addressing the roles of social and cultural influences in identity development through the lens of critical pedagogies (including images of scientist), there is a need for social justice and multicultural education in the field of elementary science education (Mensah, 2013; Moore, 2008). There is also a need for social justice education in science education because it is missing or not a major emphasis (Mensah, 2013; Rivera Maulucci, 2012). Incorporating social justice education into science allows teachers to create classroom science communities where equity, justice, and agency are at the forefront (Mensah, 2013; Moore, 2008). Approaching science education in this way further allows us to deconstruct master narratives of science and provide children from diverse backgrounds the right to learn science.

Incorporating a social justice education framework into elementary science teaching requires educators to reflect on one's own identity and commitment. Even though this study addressed students' identities, examining teachers' and teacher educators' identity is equally important (Glass, 2019; Mensah, 2016). As Glass (2019)

stated, “there is an association between creating our identity and having one created for us” (p. 70).

As a teacher of young children, I had to create my science identity. Teaching science is a part of my teacher identity because of my commitment to science education. I think that other teachers should embrace this as well because of what science is able to do for young children and how it helps them to see the world. In terms of developing a science identity, Glass (2019) emphasized “success in science (school/academic), encouragement by others (family/ teachers), and identifying ourselves, or attributes of ourselves, with respected and influential role models from our experiences” (p. 70). These components of a science identify held true for the students who participated in this study as well as teachers who teach science to young children from diverse backgrounds. A strong teacher science identity is important, as well (Eick, 2009).

Teachers need opportunities to have open discussions about the importance of science in elementary schools. Mensah (2011) suggested that it is important for teachers to explore the curriculum and find images of science teaching for the development of a science teaching identity. Also, the effectiveness of school leaders’ commitment to science education influences how teachers implement science curriculum and deliver instruction to help facilitate the growth of their science identities (Smith & Darfler, 2012). Developing a science identity is important for pre-service teachers as well. Elementary teachers must construct their identities among education and science, which allows them to see themselves as agents of change in regard to science (Mensah, 2008).

However, as elementary teachers, we are expected to possess multiple content identities and pedagogical knowledges, which could inhibit our ability to develop our

science teaching identity. According to Lee and Buxton (2011), teachers should be encouraged to have scientific practices that are aligned with their students' background knowledge, identify explicit practices within science, and build trusting and caring relationships with their students. By cultivating a caring and trusting relationship, teachers facilitate true learning for their students. Learning first happens on the interpersonal/social plane, and then it becomes intrapersonal/individual; cultures is not a separate container; from this perspective, culture mediates learning (Jordan, 2010).

Implications for Research with Young Children

When researching with young children, it was important to build a rapport with students before starting the study. I wanted the children to feel comfortable in talking to me. In this study, that part was successful. Thinking about the task and the time to complete them, many children were able to complete the tasks within 1 hour. However, all of the interviews and tasks were completed after school. The active engagement and discussions were difficult for some of the children because they had been in school all day and some appeared to be fatigued from their long school day. Also, the families have to be present for each child participant, for many children this was okay. For some of the students, I had wondered if their answers would be different if their parents were not physically present. However, with young children, all parents must be present. I wonder if having a two-way mirror would have been more beneficial. Yet I do believe, some of the children found comfort in having their parent present during the study.

Additionally, in addressing difficult topics such as race/skin tone, the IRB process for both the college and school district wanted the questions to address all difficult topics. Initially, my questions were more direct to elicit more information regarding race, but the

IRB committees wanted to ensure that my questions were approachable in a variety of perspectives. Therefore, race was not addressed in the study as directly as desired, but racial identity development was addressed.

Lastly, doing researching with young children and having a relationship with the school leadership team was imperative to conducting the study. In addition to getting approval from the IRB committees, the principal also has to grant permission as well. I am very grateful to Lincolns elementary school partnership for this research.

Families and Discussions of Race and Science

Family socialization has shown to be a prominent factor in how young children see the world and how their experiences are shaped. Families should be encouraged to have conversations early to help children feel comfortable in addressing difficult topics such as race, racial identity, and/or skin tone (Park et al., 2019; Tang, McLloyd, & Hallman, 2015). Conversations about how students see science in their everyday world is highly suggested.

Regarding families and addressing the topic of race, a suggestion for families is to engage in dialogue about topics that may or may not come up at school that is impacted by race and racism. Conversations are encouraged to happen early or in adolescence (Park et al., 2019; Tang, McLloyd, & Hallman, 2015). Another suggestion is for families to have parental goals in which they set particular outcomes for their children, especially due to adolescence being a stage where there is an increase of interaction with others and students experience a variety of social-emotional factors, academics, and/or individuals from diverse backgrounds (Harding, Hughes, & Way, 2016).

Additionally, families could benefit from having discourse about race and science. For example, when the movie Hidden Figures came out it was the first time where mainstream media acknowledged the role of African American women in STEM. Often in picture books and discourses about STEM, there seems to be a missing lens on race and science. According to Ireland, Freeman, Winston-Proctor, DeLaine, Lowe, and Woodson (2018), Black women are significantly underrepresented in STEM fields. Black women represent 7% of the US STEM fields (Ireland et al., 2018). For families, it would be interesting to share this with their children and ask their thoughts on this matter or their noticing of race and/or racial identity within science in their school and classroom. Examining the role of racial identity in the context of science education provides insights into how educators can address the power dynamics of race and their students' experiences.

The role of race and racial identity also provides insight into creating discursive structures in the science classroom. Addressing race in the context of the science classroom creates a space for open dialogue regarding assumptions about who does science and a focus on race in comparison to daily interactions. Critical literacies create a space for this type of open dialogue by bridging the gaps to difficult conversations (Farland-Smith, Arquette, & Finson, 2017; Price-Dennis et al., 2016; Souto-Manning et al., 2018). Critical literacies offer different perceptions of the stereotypical version of scientists, which often include images of White males (Barton & Basu, 2007; Chambers, 1983; Farland-Smith et al., 2017; Walls, 2012). Research has shown that over 64% of scientists portrayed are predominately male; for race/ethnicity, 95.4% of these images are Caucasian middle-aged or older (Farland-Smith et al., 2017). Reinforcing non-

stereotypical versions of science and scientists allows students to see themselves as scientists and foster a science identity (Farland-Smith et al., 2017).

Implications for University and K-12 Partnerships

Partnerships between universities and K-12 schools provide students with opportunities for student achievement and their families. The partnership between the local university and Lincoln Elementary School appeared to have a positive impact on the students. This was illustrated as students orally and in written form addressed NOS practices in the study. Currently, in science education reform, there has been a concern regarding K-12 science preparation (Komoroske, Hameed, Szoboszlai, Newsom, & Williams, 2015). There has also been a concern of scientists from universities providing more tools and guidance for K-12 science (Komoroske et. Al, 2015). NSF's Graduate K-12 (GK-12) program has been successful in providing professional development opportunities for teachers and working with local communities for science education (Komoroske et al., 2015). Partnerships between universities and K-12 schools provide students with opportunities for student achievement with increased exposure and learning of science. This then allows us to close the gap within science and STEM education (Komoroske et al., 2015). In regard to the local university partnership with Lincoln, this was also apparent and influenced parent engagement with science as well.

Partnerships with local universities and K-12 Schools can have a great impact on students and teachers. From the recent experience with the local university and Lincoln Elementary school, it would be beneficial for the university to offer professional development opportunities to teachers regarding racial identity development with young children. I think teachers would find this meaningful as they gain perspectives of

themselves as racial beings and thinking of their students from an affirming lens. By teachers examining their own identities, they are then able to have a multimodal narrative for understanding their experiences (Mensah, 2016). If teachers can understand their own experiences, then they are better able to examine their intersectionality and how their students are impacted by such themes of race, class, and gender. According to Villegas and Lucas (2002), "If they (referencing teachers) do not come to see that the so-called meritocracy works largely for those who are already advantaged in society…they will fail in their attempts to understand and respond to students…from oppressed groups" (p. 32). If teachers are not able to do this type of work, then they will not be able to see their student's full potential and only examine their students from a deficit lens.

In conclusion, this study highlighted many implications for science education, teacher preparation and teacher professional development, and university partnerships. Each implication discusses the possibilities of where educators can further gain an understanding of children.

Limitations

In examining the implications of this study, there are also limitations. There are several limitations of this study. The most prevalent limitation of this study is a mixed methods study with a low sample size of 10 children participants and 10 parent participants. With this number of participants, we are not able to provide generalizations and the results can only pertain to the participants who completed this study. The study also took place with students from one particular public school and with two additional students from an independent school.

However, there are strengths in utilizing mixed methods research designs, particularly qualitative research. Strengths of qualitative research methodologies are in-depth engagement with participants. It also provides multiple discourses in examining different theories (Denzin & Lincoln, 2018). Lastly, qualitative research methodologies provide an interpretative lens in understanding complex situations (Denzin & Lincoln, 2018). For the complex situations presented in this study which examined the role of racial identity and science identity of young children, using qualitative methods was very appropriate. Qualitative research is not meant for generalizability. Qualitative research methodologies are holistic in nature, resist providing a single paradigm in concluding with projects (Dezin & Lincoln, 2018).

The instrumentation of the study also posed limitations. The use of the drawing instrumentation of the DAST (Chambers, 1993) and the DESTIN (Mensah, 2011) to address how students' perceptions of a scientist and their characteristics within a classroom causes the researcher to infer meaning from the children's perceptions. Even with their brief descriptions and interviews, there can be more said about what the students' meant in their drawings to extract additional meaning. Perhaps adding more follow-up conversations about the students' drawings, asking the students, for example, about the positionality of the teachers, or the absence of race and gender, or the presence of chaos, could get more at their views and perceptions of science and race.

Meanwhile, the Likert survey instrumentation collected from the child and parent did not provide an understanding of the participants' cultural and racial socialization in regard to their experiences. This could have been provided by examining each participants' self-efficacy or making the questions more specific to their daily life

experiences with race and/or perceived discrimination. In addition, each child had limited experience with discussing difficult topics, such as race and the implications of race on learning. I think this was, in part, due to the children living in NYC and attending progressive schools, which could have hindered their context for racial understanding, but on the other hand could have enhanced discussions about diversity. The age of the children could have influenced their experiences as well; the children ranged in age from 8 to 10 years old.

Future Research

More research needs to be done to address the racial socialization of students and their families. Perhaps using a published protocol would have provided more reliability and validity to the tools used in the study such as a modified version of the Maryland Adolescent Development in Context study (Tang et al., 2015; Eccles, 2010). This survey addresses questions about the development of youth and their behavior with their families. This survey would need to be modified to fit the needs of this study.

Additionally, more research is needed to examine the influence of partnerships between the local university and Lincoln Elementary School, teacher positionality regarding race and science education, and family socialization. In future research studies, some possible research questions could address: What influence does university partnerships have on K-12 students' racial identity development in science learning, with attention to developing science curriculum that addresses race and science learning? How does family socialization of race influence young children's viewpoints of race, with attention to educating parents about race and science education? How can professional development support teachers in designing and teaching more race-based science

curriculum in the elementary classroom, with attention to teachers' development of racial literacy and race curriculum.

The need to address racial identity development in science education is a topic that could use more research, especially related to young children. This study focused on children aged 8-11. Challenging to get information for very young children such as this should not deter more research on this age group to understand more their ideas of race and science learning. Finally, school leaders play an important role in shaping school culture. When school leaders become more reflective in their practices and support discussion of race, even with affinity groups with students and teachers, this helps teachers and student at their schools to address the inequities in the American education system, which is influenced by the cultural and racial differences of the students being served (Gooden & Dantly, 2012; Gooden & O'Doherty, 2015).

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Appendix A

IRB Study Approval

TEACHERS COLLEGE
COLUMBIA UNIVERSITY

Teachers College IRB *Expedited Approval Notification*

To: Lisa McDonald
From: Dr. Myra Luna-Lucero
Subject: IRB Approval: 18-267 Protocol
Date: 03/16/2018

Please be informed that as of the date of this letter, the Institutional Review Board for the Protection of Human Subjects at Teachers College, Columbia University has given full approval to your study, entitled "*Identity Development* ," under **Expedited Review** (Category **(6) Collection of data from voice, video, digital, or image recordings made for research purposes.**
(7) Research on individual or group characteristics or behavior) on 03/16/2018.

The approval is effective until **03/15/2019**.

The IRB Committee must be contacted if there are any changes to the protocol during this period. **Please note:** If you are planning to continue your study, a Continuing Review report must be submitted to either close the protocol or request permission to continue for another year. Please submit your report by **03/01/2019** so that the IRB has time to review and approve your report if you wish to continue your study. The IRB number assigned to your protocol is **18-267**. Feel free to contact the IRB Office (212-678-4105 or irb@tc.edu) if you have any questions.

Please note that your Consent form bears an official IRB authorization stamp and is attached to this email. Copies of this form with the IRB stamp must be used for your research work. Further, all research recruitment materials must include the study's IRB-approved protocol number. You can retrieve a PDF copy of this approval letter as well as the stamped consent(s) and recruitment materials from the IRB Mentor site.

When your study ends, please visit the IRB Mentor site. Go to the Continuing Review tab and select "terminate" from the drop-down menu.

Best wishes for your research work.

Sincerely,
Dr. Myra Luna-Lucero

irb@tc.edu

Attachments:
- 18-267_InformedConsent_3.16.18.pdf
- 18-267_Minor Assent Form_childfinalcopy.pdf

Appendix B

DOE Approval

Department of Education
Richard Carranza, Chancellor

Research and Policy Support Group

52 Chambers Street
Room 310
New York, NY 10007

April 19, 2018

Ms. Lisa M McDonald
311 W.141st
Apt 4B
New York, NY 10030

Dear Ms. McDonald:

I am happy to inform you that the New York City Department of Education Institutional Review Board (NYCDOE IRB) has approved your research proposal, "Identity Development." The NYCDOE IRB has assigned your study the file number of 1939. Please make certain that all correspondence regarding this project references this number. The IRB has determined that the study poses minimal risk to participants. The approval is for a period of one year:

Approval Date: **April 19, 2018**
Expiration Date: **April 18, 2019**

Responsibilities of Principal Investigators: Please find below a list of responsibilities of Principal Investigators who have DOE IRB approval to conduct research in New York City public schools.

- Approval by this office does not guarantee access to any particular school, individual or data. You are responsible for making appropriate contacts and getting the required permissions and consents before initiating the study.
- When requesting permission to conduct research, submit the informational letter to the school principal summarizing your research design and methodology along with this IRB Approval letter. Each principal agreeing to participate must sign the principal informational letter. A *completed and signed letter for every school included in your research must be emailed to* IRB@schools.nyc.gov . Principals may also ask you to show them the receipt issued by the NYC Department of Education at the time of your fingerprinting.
- You are responsible for ensuring that all researchers on your team conducting research in NYC public schools are fingerprinted by the NYC Department of Education. Please note: This rule applies to all research in schools conducted with students and/or staff. See the attached fingerprinting materials. For additional information click here. Fingerprinting staff will ask you for your identification and social security number and for your DOE IRB approval letter. Researchers who join the study team after the inception of the research must also be fingerprinted. The cost of fingerprinting is $135.
- You are responsible for ensuring that the research is conducted in accordance with your research proposal as approved by the DOE IRB and for the actions of all co-investigators and research staff involved with the research.
- You are responsible for informing all participants (e.g., administrators, teachers, parents, and students) that their participation is strictly voluntary and that there are no consequences for non-participation or withdrawal at any time during the study.

Appendix C

Child Informed Consent

ASSENT FORM FOR MINORS

Protocol Title: Identity Development
Principal Investigator: Lisa M. McDonald, Doctoral Candidate 757-773-3953
lmm2238@tc.columbia.edu

INTRODUCTION

Hello, my name is Lisa McDonald and I am a doctoral candidate in Science Education at Teachers College, Columbia University. I would like to invite you to participate in a research study called "Identity Development." If you agree to participate in the study called "Identity Development", you will be participating along with 10 to 15 other children for this study. This study will explore the role of children's racial identity and influences on science learning. If you agree to participate, please write your name on the line below:

I_____ (child's name) agree to be in this study, titled "Identity Development". What I am being asked to do has been explained to me by **Lisa M. McDonald,** Principal Investigator. I understand what I am being asked to do and I know that if I have any questions, I can ask **Lisa M. McDonald**, Doctoral Candidate at any time. I know that I can quit this study whenever I want to and it is perfectly OK to do so. It won't be a problem for anyone if I decide to quit.

Name: _____
Signature: _____
Witness: _____Date: _____

Investigator's Verification of Explanation

I certify that I have carefully explained the purpose and nature of this research to _____ in age-appropriate language. He/she has the

opportunity to discuss it with me and knows that they can stop participating at any time. I have answered all of their questions and this minor child has provided the affirmative agreement (assent) to participate in this research study.

Investigator's Signature _____ Date _____

Appendix D

Child Assent Form

Teachers College, Columbia University
525 West 120th Street
New York NY 10027
212 678 3000

ASSENT FORM FOR MINORS

Protocol Title: Identity Development
Principal Investigator: Lisa M. McDonald, Doctoral Candidate
757-773-3953, lmm2238@tc.columbia.edu

INTRODUCTION

Hello, my name is Lisa McDonald and I am a doctoral candidate in Science Education at Teachers College, Columbia University. I would like to invite you to participate in a research study called "Identity Development." If you agree to participate in the study called "Identity Development", you will be participating along with 10 to 15 other children for this study. This study will explore the role of children's racial identity and influences on science learning. If you agree to participate, please write your name on the line below:

I_____ (child's name) agree to be in this study, titled "Identity Development". What I am being asked to do has been explained to me by **Lisa M. McDonald,** Principal Investigator. I understand what I am being asked to do and I know that if I have any questions, I can ask **Lisa M. McDonald**, Doctoral Candidate at any time. I know that I can quit this study whenever I want to and it is perfectly OK to do so. It won't be a problem for anyone if I decide to quit.

Name: _____

Signature: _____

Witness: _____Date: _____

Investigator's Verification of Explanation

I certify that I have carefully explained the purpose and nature of this research to _____ in age-appropriate language. He/she has the opportunity to discuss it with me and knows that they can stop participating at any time. I have answered all of their questions and this minor child has provided the affirmative agreement (assent) to participate in this research study.

Investigator's Signature _____

Date _____

Appendix E

Parent Consent

Teachers College, Columbia University
525 West 120th Street
New York NY 10027
212 678 3000

PARENTAL PERMISSION AND INFORMED CONSENT FORM

Protocol Title: Identity Development
Principal Investigator: Lisa M. McDonald, Doctoral Candidate
757-773-3953, lmm2238@tc.columbia.edu

INTRODUCTION
You are being invited to participate in this research study called "Identity Development." Also, I am inviting your child to participate along with 10 to 15 other children for this study. This study will explore the role of children's racial identity and it's influence on their science learning. The entire process for this study will take about 3.15 hours. All of study activities will be done at Teachers College, Columbia University at a time that is convenient to you and your child. We will meet once over the course of four allotted Saturdays.

Audio recording is part of this study. After the audio recording is written down (transcribed), the audio recording will be deleted. If you do not wish for you or your child to be audio-recorded, you will not be able to participate in this study.

WHY IS THIS STUDY BEING DONE?
This study is being done to determine how to give students more access to science learning in their school and community. The findings may help me understand how students develop their identity within science and also help me learn a little more about their race, or identity, in science education.

WHAT WILL I BE ASKED TO DO IF I AGREE TO TAKE PART IN THIS STUDY?
For this study, I will ask you and your child to do five things.

- First, during a one-on-one interview, I will ask your child some questions that pertain to racial identity. This interview will be audio-recorded.
- Second, I will ask you (as parent or guardian) to complete a survey about your parental involvement regarding your child, your impression of science, and your thoughts on race. This survey will take approximately 45-60 minutes.
- Third, I will have your child look at some pictures and we will talk about where your child sees science. The photo task will take approximately 10-20 minutes.
- Fourth, I will ask your child to draw a picture of a scientist. The drawing task will take approximately 10-30 minutes.
- Lastly, I will ask your child to complete a survey. The survey will take approximately 20-30 minutes with your child. This survey is to get an idea about how your child feels about certain statements. Some of the statements on the survey will pertain to sensitive statements regarding race. The survey will give your child 5 choices to choose from. For example: **Definitely Disagree** = you strongly feel that this choice does not match how you feel; **Disagree**= this choice does not match how you feel; **Neutral**= you are unable to pick a choice that matches how you feel/you are unsure; **Agree**= you that this choice matches how you feel; **Definitely Agree** = you strongly feel that this choices matches how you feel.

WHO CAN ANSWER MY QUESTIONS ABOUT THIS STUDY?

If you have any questions about taking part in this research study, you should contact the principal investigator, Lisa McDonald, at 757-773-3953 or at lmm2238@tc.columbia.edu
You can also contact the faculty advisor, Dr. Felicia Mensah at 212-678-8316 or fm2140@tc.columbia.edu

If you have questions or concerns about your rights as a research subject, you should contact the Institutional Review Board (IRB) (the human research ethics committee) at 212-678-4105 or email IRB@tc.edu. Or you can write to the IRB at Teachers College, Columbia University, 525 W. 120th Street, New York, NY 1002. The IRB is the committee that oversees human research protection for Teachers College, Columbia University.

PARTICIPANT'S RIGHTS

- I have read and discussed the informed consent with the investigator. I have had ample opportunity to ask questions about the purposes, procedures, risks and benefits regarding this research study.
- I understand that my (and my child's) participation is voluntary.
- I may refuse to allow my child to participate or withdraw participation at any time without penalty.
- The investigator may withdraw me and/or my child from the research if they feel that he or she is not able to complete all parts of the study or if my child becomes severely distressed from the study.
- If, during the course of the study, significant new information that has been developed becomes available which may relate to my willingness to allow my child to continue participation, the investigator will provide this information to me.
- Any information derived from the research study that personally identifies my child will not be voluntarily released or disclosed without my separate consent, except as specifically required by law.
- I should receive a copy of the Informed Consent document.

My signature means that I agree to participate in this study

Print name: _____
Date: _____

Signature: _____

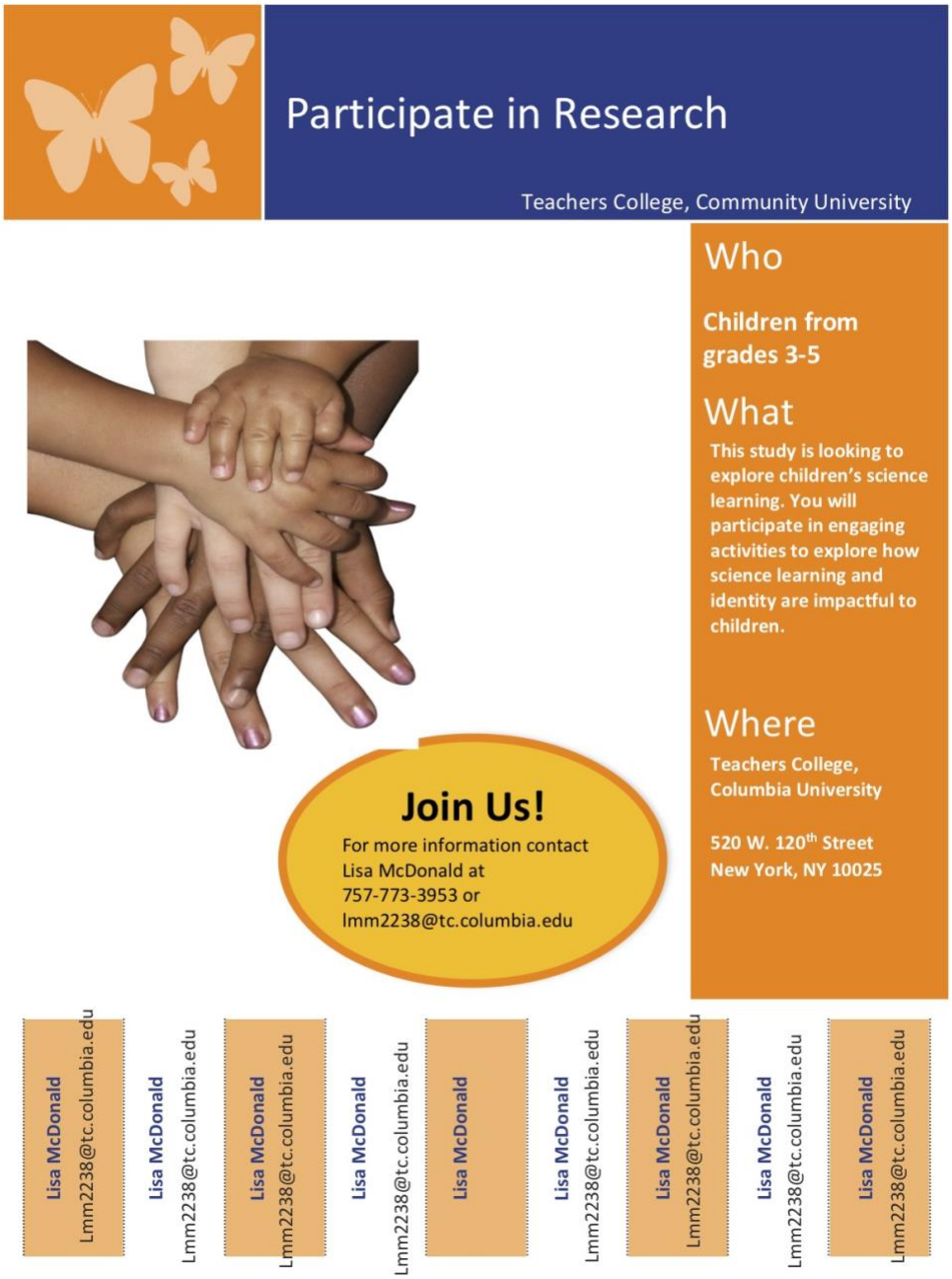
My signature means that I agree to allow *my child* participate in this study

Child's name: _____

Print Parent or Guardian's name: _____
Parent or Guardian's signature: _____
Date: _____

Appendix F

Research Flyer



Appendix G

Child Measurement Tools: Child Interview Protocol

Greeting: "Hi insert child's name! Thank you for coming to meet me today. Your participation in this study is for me to understand how the identity of children impacts their science learning. **Identity is a term to understand who you are**, for example one part of your identity is your race. Someone may identify as being "Biracial" or "African-American". Today, I will ask you to do four things. First, I will ask you some questions to get to know you. Then I will have you complete a survey. Next I will have you look at some pictures and we will talk about where you see science. Then, I will ask you to draw a picture of a scientist. Lastly, I will ask you to draw a picture of your not-ideal science teacher. Do you have any questions for me, before we start?"

Consent Form: Before we get started, I would like you and your family to read the Informed Consent forms and verify your participation by signing each form. If you and your family have any questions, please let me know. Please note that your participation is voluntary and you can withdraw from the study at any time.

Tape Recorder Instructions: As a participant of this study, all conversations will be voice recorded to get all the details. All recordings will remain confidential without any reference to you. For each session that is recorded, I will inform you "I am turning on the recorder and let me know when you are ready".

Time of Interview: _____
Date: _____
Place: _____
Interviewee: _____
Age: _____
Gender: _____
Ethnicity: _____

Research Question:
How does the role of racial identity influence children's approach to learning science? In what ways does racial identity inhibit children's conceptions to learning science? In what ways does racial identity encourage or discourage student's access to learning science?

Research Purpose:

This study will explore the role children's racial identity takes in influencing their science learning. Second, I will explore the role that children's racial identity plays on their access to and experience with learning experiences within science. Finally, I will investigate whether children need to be able to see themselves as scientist in order to feel successful as science learners and how their parent's involvement influence these factors.

Position of Interviewee:

I am a student at Teachers College, Columbia University and I am working on a project to understand how the identity of children impacts their science learning.

Questions:

1. What grade are you in?
2. What is your favorite food?
3. How do you like ___ grade?
4. When is your birthday?
5. What do you like to learn about in school?
    a. What do you like about school?

Interviewer Reflection:

1. What you know about science?

   Interviewer Reflection:

2. Where do you see science around you?

   Interviewer Reflection:

3. What are you learning about in science in your class at school?

   Interviewer Reflection:

4. How would you describe yourself?
    a. Where is your family from?

   Interviewer Reflection:

5. Do you talk about race at school?

    a. (If yes) Who do you talk about race with at school?

Interviewer Reflection:

6. Do you talk about race at home?

    a. (If yes) Who do you talk about race with?

Interviewer Reflection:

11. What type of science have you done at school?

Interview Reflection

Appendix H

Child Measurement Tools: Photo Elicitation

Directions: Take a look at this photo on the smart board or at your table. What about this photo makes you think of science? Where do you see science in this photo?

Photo 1

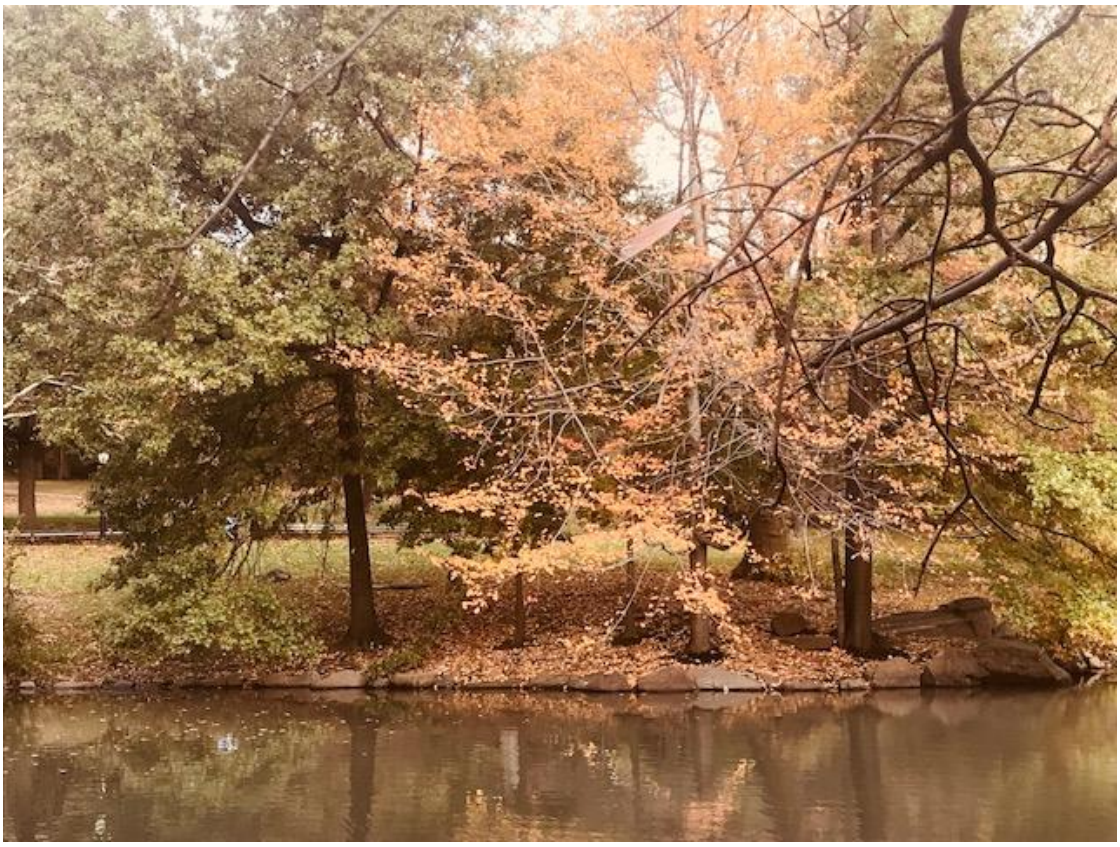
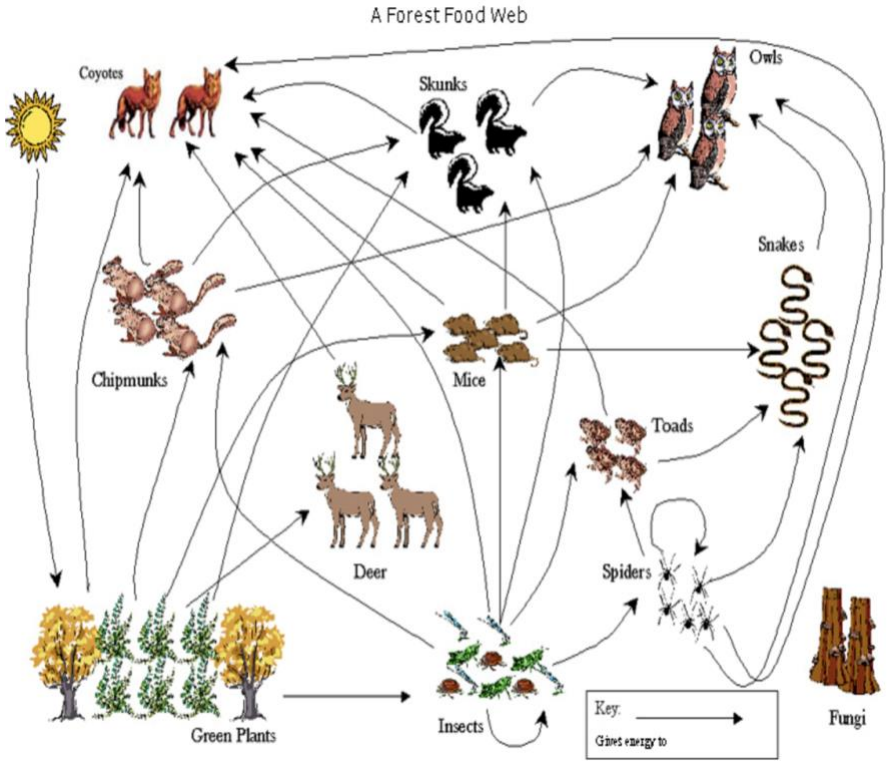


Photo 2

Photo 3


A Forest Food Web
Coyotes
Skunks
Owls
Snakes
Chipmunks
Mice
Toads
Deer
Spiders
Green Plants
Insects
Fungi
Key:
Gives energy to

Appendix I

CHILD MEASUREMENT TOOLS: SURVEY

This survey is to get an idea about you feel about certain statements. The survey will give you 5 choices to decide from. Here are some definitions to help you with your choice:

1. **Definitely Disagree** = you strongly feel that this choice does not match how you feel.
2. **Disagree**= this choice does not match how you feel.
3. **Neutral**= you are unable to pick a choice that matches how you feel or you are not sure.
4. **Agree**= you that this choice matches how you feel.
5. **Definitely Agree** = you strongly feel that this choice matches how you feel.

Step 1: Before, we get started I want you take a look the different faces. Which face matches the choice from above?

Step 2: Next, I would like for you to practice reading a few statements and making a choice that best fits how you feel about each statement. If you need help, I can read each statement to you.

I like going to the park.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

I enjoy reading.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Directions: Please read each of the following statements. (If you need help reading each statement, I can read each statement to you). Then circle the number that matches your choice. For each statement there is also a follow up question to help me learn more about the choice you have chosen. These follow-up questions will be audiotaped.

1. I enjoy learning about science.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Follow-up Question: Why do you enjoy science? or Why do you not enjoy science?

2. I feel like I can talk my family about anything

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Follow-up Question: Why do you feel that you can talk to your family about anything? or Why do you feel that you cannot talk to your family about anything?

3. I feel successful at school.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Follow-up Question: Why do you feel that you are successful at school? or Why do you feel that you are not successful at school?

4. I feel comfortable talking about topics like skin color.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Follow-up Question: Why do you feel comfortable talking about topics like skin color or Why do you not feel comfortable talking about topics like skin color?

5. I feel comfortable talking to my (family? teachers?) about difficult topics like race.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Follow-up Question: Why do you feel comfortable talking to your family or teachers about difficult topics like race or Why don't you feel comfortable talking to your family or teachers about difficult topics like race?

6. I prefer having friends who don't look like me

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Follow-up Question: Why do you prefer having friends who don't look like you?

7. I prefer having friends who look like me

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Follow-up Question: Why do you prefer having friends who don't look like you?

8. In my opinion, anyone can be a scientist.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

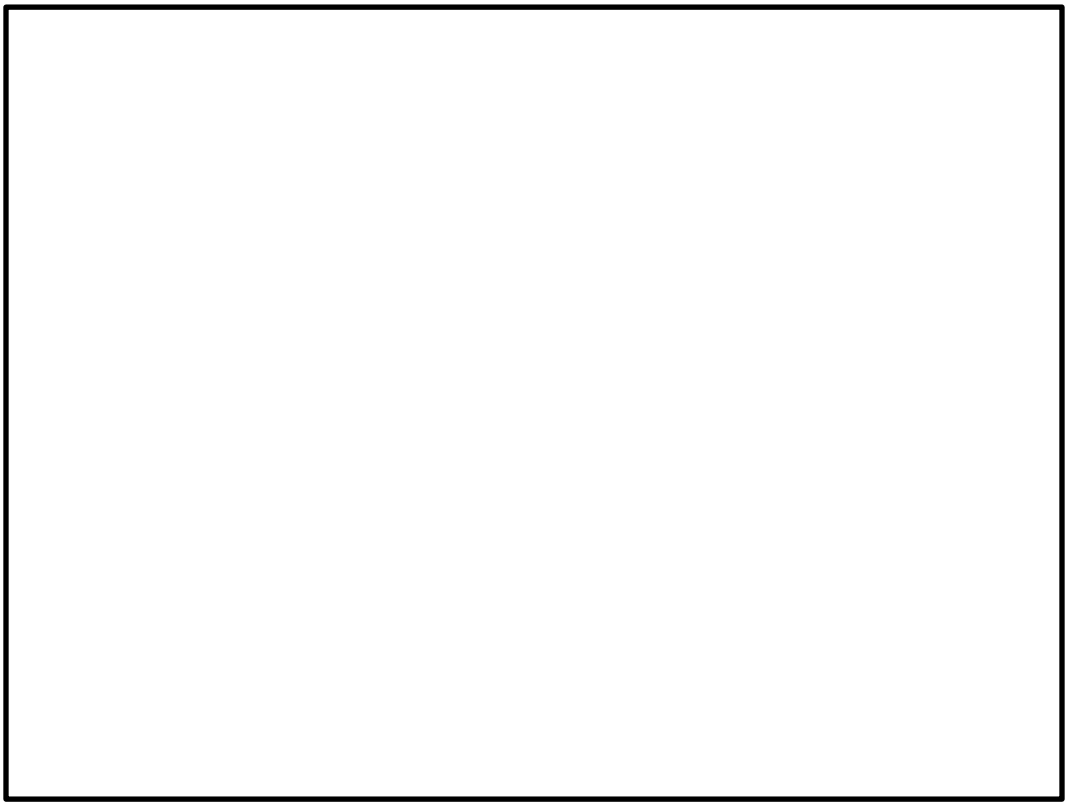
Follow-up Question: Why do feel like anyone can be a scientist or Why don't you feel like anyone can be a scientist?

Appendix J

Child Measurement Tools

Part 1. DAST Draw-A-Scientist-Task:

Directions: Draw a picture of a scientist.



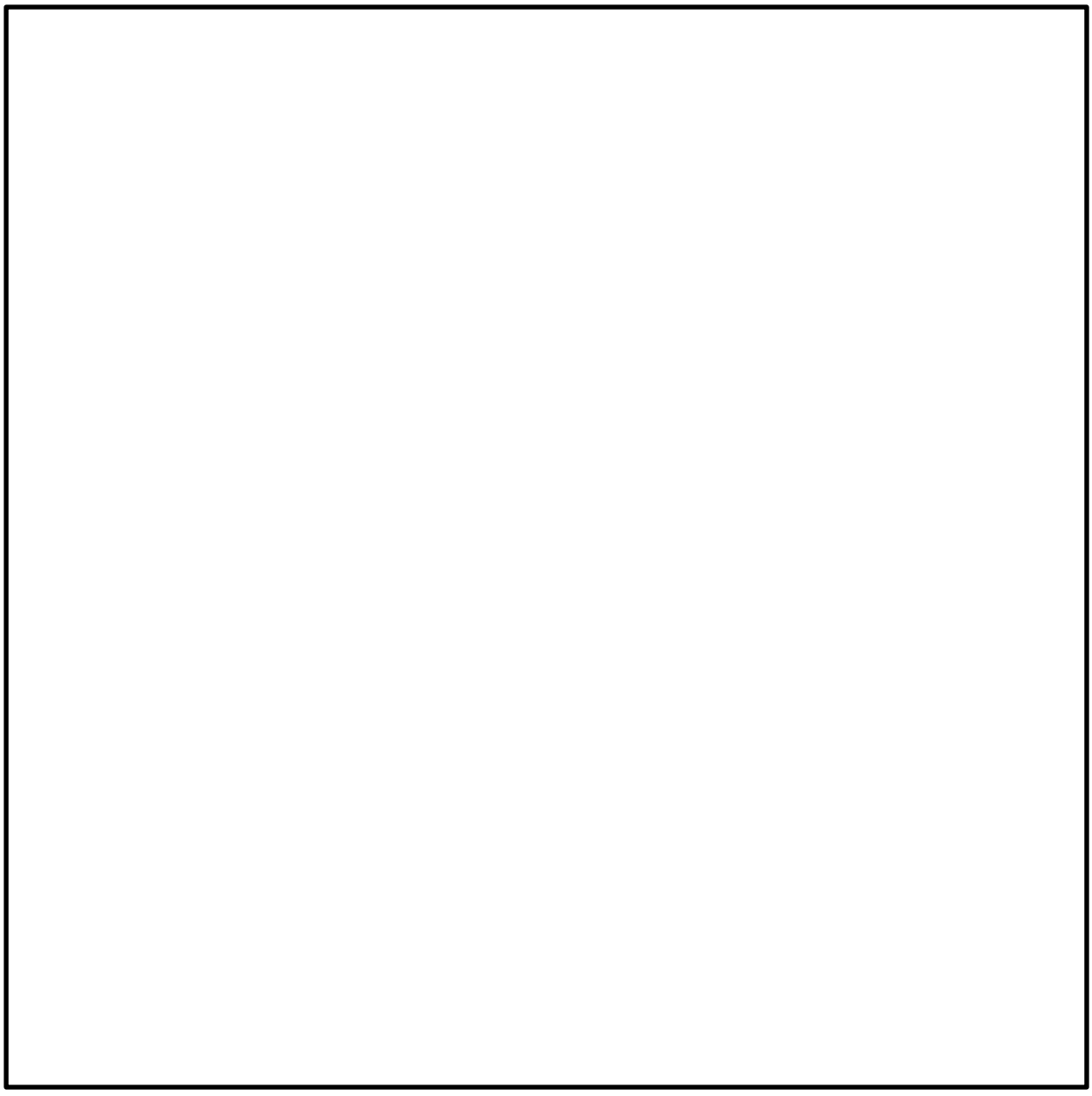
Describe your picture in words:

Appendix K

Child Measurement Tools

Part 2. DESTIN Draw-the-ideal-not-Scientist-Teacher:

Directions: Draw a picture of what a science teacher should not look like in class



Appendix L

Parent Survey

Directions: Please read each of the following statements. Then circle the number that best matches your choice. Please feel free to add any comments that you have with the statements.

1. The amount of homework a child does signifies academic success.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

2. I was taught science in elementary school.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

3. I am able to help out with my child's homework.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

4. I have always enjoyed science.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

5. My child school could benefit from a family science event.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

6. I feel comfortable talking to my child's teacher.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

7. My child's school is welcoming to parents.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

8. As my child has gotten older, my involvement with homework has decreased.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

9. Working parents are not able to be involved at school events.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

10. I liked science in elementary school.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

11. My child's school offers parent involvement opportunities.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

12. I support science being taught in school more frequently.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

13. I'm interested becoming more involved in my child's science learning.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

14. I have volunteered at my child's school.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

15. There are inequities among parents who work in comparison to parent's who don't work in regards to school involvement.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

16. I am not a working parent.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

17. Hands on science opportunities are worthwhile for my child.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

18. I have always enjoyed learning about science.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

19. Engaging in scientific practices, such as inquiry, observation, and predictions give students hands on experiences.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

20. I am involved in my child's homework.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

21. It is important for schools to welcome all families regardless of background and socioeconomic status.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

22. My child enjoys science.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

23. I am able to find opportunities outside of school for my child to engage in science.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

24. Parents can be an important factor in students pursuing interest in science.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

25. I am aware of the science resources in my community.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

26. I am familiar with my school's science curriculum.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

27. My child has participated in Teachers College Science Day at their school?

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

28. I have had difficult conversations with my child regarding race.

Definitely Disagree	Disagree	Neutral	Agree	Definitely Agree
1	2	3	4	5

Comment:

Thank you for your responses and comments!