Nurturing Black Girl Imagination: Using Portraiture to Disrupt the Omnivisibility of Black Girlhood and to Illuminate Black Girls' Childhoodness, Creativity, and Criticality in Science Learning Spaces

by

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A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Educational Studies)
in the University of Michigan
2022

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Dedication

To the Queen B herself, Estella Burrell, this is for you. Although you are no longer with me physically, your belief in me, high expectations, and love have continued to push me. My greatest wish is to have you here, but since you are not, I'll continue reciting Psalms 23 and making you proud. Grandmother, I love you forever and ever!

Acknowledgements

First, all glory and honor to God. Whew! I am extremely grateful to have made it to this point in my journey. I did not make it here alone. Thank you to my community of loved ones, mentors, and colleagues who have traveled this road with me and pushed me along the journey. Very few receive this opportunity, especially those who look like me, and I am extremely grateful to stand here Black and very, very proud.

Giving Honor to the Past

This moment would not have been possible without those who have come before me, those whose shoulders I stand upon. To those I have never had the pleasure of meeting—my African ancestors who survived the Trans-Atlantic Slave Trade and my ancestors of the Narragansett Tribe of Rhode Island who survived the genocide of Native peoples—I thank you. Your fight to survive and thrive have led me here.

To my granny, Patricia Sizemore and my granddaddy, Leroy E. Sizemore. Thank you for leading the way, modeling daily what it means to be integral parts of your community and to serve community in ways that make a difference. Granny, thank you for exhibiting what it looks like to lead through service and granddaddy, thank you for showing me what it looks like to take center stage and lead fearlessly. I am grateful for the dinner table conversations, the amazing meals, and the reminders from near and far that I am loved. I miss and love you both.

To my grandmother, Estella Burrell. An educator, mother, grandmother, and friend. The epitome of class, humor, beauty, and just realness. I miss you every single day, but in your absence, I am consciously making the effort to live the legacy and make you proud. I appreciate

the moments you pushed me out of my comfort zone as a young Black girl. You invested in my criticality and creativity, and I am forever grateful for that. I love you forever.

Celebrating the Present

To my husband, Ryan Davis. You went from my boyfriend, to fiancé, to husband, all while pursuing this degree. Wow! Words cannot describe how much you have carried me during this process. Thank you for wiping my tears, pumping me up, massaging my shoulders, and propelling me forward with your unwavering belief in my ability to finish this. Thank you for celebrating the small moments and reminding me of my brilliance in moments of frustration and fatigue. You have been more than a companion on this journey. You have been the best cheerleader, confidant, and motivation every step of the way. I am beyond blessed to achieve beyond my dreams with you. I love you!

Mommy, Kathy Sizemore, thank you for your unconditional love and unwavering support for anything I chose to do. You have modeled the epitome of a Godly women, standing firmly in her faith and the promises of God. The foundation you have laid within me of Godliness and my faith in Jesus have gotten me here. Words cannot express how grateful I am for you and the example you have set. Mommy, thank you for your resilience and for choosing *you* in difficult time. Thank you for ensuring my childhood was filled with beautiful memories that still bring me joy in my adulthood. I am strong and unrelenting because of you! I love you, mommy!

Daddy, Leroy Sizemore, your companionship throughout this dissertation process has been pure joy. We have learned more about each in the last few years than ever before. Your support and concern for my well-being and success during this phase has meant the world to me. You saying, “You’re a Sizemore. There’s nothing you can’t do!” echoes in my ear and has

pushed me in moments of uncertainty. I am praying this is only the beginning of what our relationship becomes in the future.

Ashlee, Ash, what can I say. As a little girl, I always wanted to be just like you. I wanted to have my hair like yours. I wanted to dress, talk, and behave like you. You set a beautiful blueprint for me to follow until I was able to fly on my own. Thank you for giving me the blueprint on which my life has been built upon. I am flying simply because I have watched you soar. Keep soaring sister! Piece of cake.

To my village of aunties, Aunt Becky, Aunt Cheryl, Aunt Niecy and Aunt Vick. It has been beautiful to see the diversity of Black womanhood in the ways you each live your lives and how each of you has triumphed beyond obstacles with such grace. I am thankful for the love that each of you has shared and the lessons you have taught me. Your influence on me as a Black girl and Black woman are foundational to this achievement. Thank you!

Aunt Becky, there are some relationships that cannot be described with words. It's a feeling, a connection that can only be felt between those two people. That is our relationship. We have an unspoken bond that has carried me through many tough times and has enhanced the joy in the beautiful times, as well. This bond has also allowed you to be the voice of reason in moments of contemplation and has placed you in position to be a terrific celebratory partner. Aunt Becky, thank you for simply being you. Thank you for all you do for our family, but specifically, all you have done for me. I admire you and want to be like you. I will continue to "Do it Afraid."

To those who come behind me, to my younger cousins, nieces and nephews, and Godchildren, may you use my shoulders as elevation as you reach to achieve your own wildest dreams. May you take time to think about what you love to do and then chase after it,

passionately. May you know that you can do anything with Jesus, consistency, and a beautiful support system cheering you on. I will always be in the stands screaming loudly because you can do all things through Christ who strengthens you.

I am incredibly grateful to my sister-friends that I have known for a lifetime and others for only a short while. I am thankful for your authenticity, beauty, and brilliance. Each of you brings out the best in me in such diverse ways. I am better because of our friendships. To my childhood besties, Brittanie and Krishna, I am grateful for the longevity of our sisterhood. I am grateful that no matter how much time passes, I can count on the two of you to be a source of comfort and support. We are rocking until the wheels fall off. To the sister-friends I gained while at Spelman College, April, Shannon, Adetoun, Ebony S., Courtney, and Crystal J., what beautiful memories we have made and what amazing ones await us in the future. Each of you exude such fire and zest for life that I admire. It is only the beginning for what we each will accomplish. I am grateful to each of you for your motivation during this process and your excitement for my success.

My doctoral experience has been enriched because of the beautiful souls I have had the pleasure of learning with and from. I am grateful to Ashley, Paulina, Naomi, Amber W., Christine, Ebony, Crystal W., Kim, Dana, Jacquie, Gabe, Maggie, Nic, and Rebecca for your friendship, mentorship, and motivation throughout the past five and a half years. University of Michigan would have been a bleak place without each of you. I am excited to see what you accomplish. I look forward collaborating with you as we shift education for the better.

To my students who have set me on this path of improving education, who have given me faces and stories to put toward the reason I studied and have pursued this degree, thank you. Thank you for trusting me as your teacher. Thank you for being honest with me. Thank you for

staying afterschool to build community while learning how to balance equations. I also do this for you.

I have had the pleasure of being advised by two dynamic women, Leah Bricker and Deborah Loewenberg Ball. Leah, thank you for the guidance and reassurance I needed as I started this program. You were a constant source of affirmation as I was seeking to determine how I fit into such a large field. Thank you, Leah, for confirming what I knew I had in me and helping me hone my skills of research and presentation, which have continued to evolve today. Your mentorship at the beginning of my doctoral process is invaluable.

Deborah, you are a force. I am amazed by your brilliance. I still stand in amazement of all you have accomplished and how you so beautifully center children in your work. Thank you for showing me what authentic scholarship can look like. Thank you for reminding me that I have what it takes to not only make it to the finish line, but I could make it there being fully and authentically myself. I am beyond grateful for the relationship we have been able to develop. I truly pray we stay connected for life. Prior to you being my advisor, I admired your brilliance from afar, but am beyond grateful to have had an opportunity to learn with you, be mentored by you, and to gain you as a trusted friend and confidant. I truly believe you were God ordained and I am beyond thankful to have been blessed with you.

I also extend sincere gratitude to the other members of my dissertation committee, Megan Bang, Audrey Bennett, and Carla O'Connor. Megan, you, and thus your scholarship, are phenomenal. Your work to push what is considered scientific and whose epistemologies and ontologies are centered set me on the trajectory of the work presented in this dissertation. Thank you for your unapologetic boldness to speak truth to power. You are an inspiration. Audrey, your passion for art is contagious and your commitment to centering Black voice in artistic expression

is amazingly beautiful. I am beyond grateful to have been able to learn from you and grow as a scholar through your expertise. Carla, you are such a beautiful representation of Black woman brilliance. Your presence alone has meant more to me than you can imagine. I originally found it hard to find my place in the doctoral space, but your presence consistently reminded me that I belong and the high quality of work you develop has challenged me to be a better scholar. Thank you for being you.

Looking Toward the Future

To my beautiful baby. I don't know very much about you, yet, as you are still growing and forming in my womb. I do know at this very moment that I already love you so much! You have come into our lives at the perfect time. Your dad and I couldn't be more grateful that you are joining our family. I hope all that I have accomplished both professionally and personally allows you to see that you too can do hard things. I hope you are confirmed that there is nothing *you* cannot do. Your doctor-mommy is eager to meet you and to experience the world through your eyes. I love you forever, already!

Table of Contents

List of Tables

List of Figures

List of Appendices

Abstract

This study explores how Black girls express their *Black girl imagination* while participating in a critical, informal science learning program, Empowering Girls Through Art & Science, designed to prioritize the positive visibility of Black girls and promote the critical exploration of scientific histories. The goal of the research was to identify ways Black girls actualize their *Black girl imaginations* through expressions of childhood, criticality, and creativity. Three questions structured the study: (1) How do adolescent Black girls express their *Black girl imaginations* when participating in a critical, informal science learning space designed with them in mind? (2) What do their expressions of *Black girl imagination* reveal about their articulations of self? (3) What do their expressions of *Black girl imagination* reveal about their meaning making in science?

The framework for the study is constructed from three theoretical perspectives—Black girlhood studies, critical race-informed science education, and afrofuturism. I use Black girlhood studies to acknowledge that Black girls occupy unique intersections of identities, distinct from Black women, which yield a unique criticality and creativity. I use two tenets of critical race theory—colorblind racism and whiteness as property—to acknowledge the ways Western, Eurocentric approaches to science are exclusionary, and, in response, I articulate five shifts for revolutionizing science education to center Black girls. I use afrofuturism to legitimize the Black imagination, expand what is considered scientific, and redefine how time is conceptualized.

The methodology of portraiture is used to understand how Black girls question the status quo, take critical stances against injustice, and create change where their voices are systemically

excluded. Findings are presented as visual and narrative portraits of three focal participants. I draw on program applications, semi-structured interviews, focus groups, video diaries, participants' artistic expressions, and researcher memos.

Analysis of the data demonstrates that these Black girls are thinking deeply and critically about the world. Offering spaces where Black girls can authentically express their childhoodness, share their critical perspectives, and communicate creatively allows for the development of counterstories of Black girls in science learning environments. These counterstories in the form of portraits present three distinct representations of Black girls in science.

This dissertation offers a layered counterstory—a combination of multiple counterstories that work together to center marginalized stories and ways of storytelling across a research process—that allow for the elevation of Black girl meaning making.

This study has important implications for stakeholders in science education. This study reveals to classroom teachers that children can navigate across multiple epistemologies of science and hold the capacity to grapple with science from a variety of perspectives. It confirms that teacher educators must prioritize moments to unpack preservice teacher bias, explore Black, Brown, and Indigenous scientific histories, and practice embedding and facilitating opportunities to learn.

Science education scholars should consider the layered counterstory when seeking to center marginalized voices and more opportunities to elevate Black girl meaning making is critical. Narratives that illuminate Black girls' beauty and brilliance, told from their perspectives, deserve to be centered and celebrated. My hope is that by elevating Black girl voice in this dissertation, the fields of science education take the brilliance and beauty of Black girls as

axiomatic and begin to redefine the structures that currently guide the disciplines to move Black girls from the margins of science learning to the center.

Chapter 1
Introduction

With tears in our eyes, we laughed! Bent over, hands slapping thighs, laughing. Tears, tears of joy that is, flowed down our cheeks. As always, my tears flowed more vigorously than hers. We did this often when we got together. Two brown skin girls, Black girls, reminiscing on the last 20 years of our friendship, our sisterhood. The story that brought tears to our eyes that day almost always incited laughter every time Brittanie brought it up.

> You *always* wanted to play school! We were in 8th grade, and you *still* wanted to play school! I didn't know how to tell you, but I hated acting like a teacher and pretending to be teaching some ol' make believe kids, but you loved it. I just did it because it made you happy.

Brittanie rolled her eyes and immediately looked at me with a gaze that seemed to acknowledge the same glimmer of passion for education, teaching, and creating that I feel so strongly within myself today. I am not sure if she actually saw any of that, but what I know for sure is that she saw something in me that I often have to fight for others to see in me when I am out in the world. At that moment, I felt visible to her. Me in all my Black womanness and former Black girlness with all my creativity, imagination, and passion—she saw me.

Growing up, I loved "playing school." Imagining myself as the teacher brought me so much joy. When Brittanie and I played, I always made her the social studies and reading teacher, and I was the science and math teacher. Apparently, she hated it, but I loved every second.

My grandmother was a fifth-grade special education teacher, so she would give me her unused gradebooks from the previous school year. I absolutely loved that! I would fill out the attendance sheet with my students' names, all of which I made up, and would call each of their names out loud for attendance in my Black Barbie themed bedroom. "Darrione, Imani, Kelsey, Calvin…!" Following each name with an "x" or check mark to signal if they were present or absent. There were always a few students absent. I wrote the names of all my students on popsicle sticks and pulled them out one by one to encourage my students to answer random questions I would ask. In my teaching, I was strategic. I would mimic things I saw my teachers do that I thought were helpful. I also imagined myself in similar situations as some of my teachers who I thought had handled situations poorly. In my bedroom classroom, I found myself confronted with similar situations but chose to handle them in ways that were more compassionate toward students' circumstances and sought the humanity of each child.

My creativity and imagination didn't stop with "playing school." I grew up as an extremely creative and imaginative Black girl. I was always in pursuit of opportunities to create something, whether it was repainting all my bedroom furniture in beautiful pastel colors or designing clothes and hosting a fashion show in my grandmother's backyard to raise money to fund my Kidz Kreative Korner art-themed babysitting business. In my years as an adolescent Black girl, I was constantly identifying problems and developing innovative solutions with a bit of a flair.

I often found myself in various imagined places that may have simply looked like a driveway, backyard, or bedroom to someone else. To me these spaces transformed into drive-through windows of my favorite fast-food restaurants where I could order anything I wanted or

me sitting on the stage of *The Oprah Winfrey Show* and Oprah asking me about how opening her school in Africa inspired the opening of my school for Black children in the U.S.

This imagination that I had as a young Black girl was palpable for me. It felt like I was literally being transported to new worlds, where I could be exactly who I wanted to be and my age, financial resources, neighborhood, race, and gender were beneficial, not detrimental, to my journey. Having spaces where my imagination could roam free was integral to my childhood experience. The same feeling was evoked when my best friend of 20 years, Brittanie, looked at me and *saw* me. With her, I was free to be a young Black girl stretching and experiencing the depths of my imagination. The liberatory practice I gained from being imaginative in my youth continues to fuel my ability to envision anew as a Black woman today.

Unfortunately, my imagination went unnoticed in school. Although math and science were my favorite subjects throughout my elementary, middle, and high school matriculation, I never felt my imagination or creative capacity being nurtured in those spaces. Because a large component of my Black girlhood experience was steeped in my creative capacity and the manifestations of my imagination, how could school be a place where I felt fully seen if those aspects of my being were not recognized? How could school be a space where I could be most authentically visible to my teachers and my peers? I was not able to bring my full being into classrooms reserved for the teaching and learning of math and science.

I am convinced the imagination and creative capacities of Black girls can thrive in spaces traditionally reserved for the teaching and learning of disciplinary content knowledge. In this dissertation, I argue that privileging Black girls' imaginations, particularly in science learning environments, has the potential to cultivate spaces where Black girls can see themselves and be fully seen by others.

The Power in Pausing and Noticing

To see Black girls and all their intricacies requires all stakeholders in their lives to prioritize opportunities to pause and notice. There is power in the disruptive act of pausing and noticing. In her book *Restorative Yoga for Ethnic and Race-Based Stress and Trauma*, Dr. Gail Parker (2020) acknowledges the healing power associated with noticing and honoring the "everydayness of life; those ordinary things you don't normally pay attention to because they are routine..." (p. 152). Parker reminds the reader of the importance of pausing and noticing that is threaded throughout the well-known novel *The Color Purple* by Alice Walker. In the novel, Walker (1983) describes God's disappointment "when you pass by the color purple in the field without noticing it" (p. 191). The act of noticing the color purple, or the sunset, or the clouds in the sky, or the mud puddle left after a rainfall assigns worthiness to the items and moments that get so easily overlooked and are undervalued (Parker, 2020). Parker argues that taking time to pause and notice the simple things in life has the profound ability to reduce stress because we are then able to reawaken our awareness that beauty resides in all beings. We are able to decenter ourselves and the selfish pursuits that guide us to consider others' valuable.

Parker adds that "the paradox is that by noticing the sacred in the ordinary, we experience the extraordinary" (2020, p. 152). If it is so necessary for us to pause and notice the seemingly mundane aspects of life—the flowers in the field and the birds in the sky—how much more meaningful is it for us to pause to notice and see Black girls for who they say they are? The power of making Black girls visible in our schools and in society daily enables us to experience the extraordinariness of Black girlhood that has always been there but is often overlooked or misunderstood.

My Positionality

I am a Black woman, a former Black girl; a Black girl who has gone unseen and unnoticed in many spaces but who has also been celebrated and made the center of attention in my home and in my community. Who I am, where I come from, and my experiences guide me and shape the way I designed, facilitated, and present this dissertation study. I must acknowledge both my identities that are recognizable and are noticeable without getting to know me and those that emerged more subversively in my engagement with research participants and the research process.

As Daughter, Granddaughter, & Niece

I am a native of Dayton, Ohio. Although I have lived in various places, I have deep Midwestern roots. As a daughter of a single mother, I was raised by my mom, grandmother, and two aunts, and because of that I enter every space believing Black women can literally do anything. I spent most of my childhood in a middle-class home with my mom, grandmother, and older sister. I grew up staying too long in the pool until my lips turned blue, drinking Lipton hot tea and eating Gala apples with the skin removed (of course), sitting in the alto section of the choir stand at church with my grandmother, and riding bikes in the middle of the street even though my mom said not to. I grew up equally a daughter and a granddaughter and learned about the resilience and exceptionality of Black womanhood through up-close examples.

My mom and grandmother both attained post-secondary degrees before I was born. In addition to a bachelor's degree, my grandmother had received a master's in education and held a school administrator's certification. My two aunts, Aunt Cheryl and Aunt Becky, completed their bachelor's and master's degrees while I was old enough to see and understand the accomplishment. Education was important in my home and in my family. There was never really

an explanation as to why it was so important, but it was important, nonetheless. So, I sought to obtain as much education as possible.

As Educator, Scientist, & Researcher

I have always attended predominantly Black K-12 schools where many of my teachers were Black and had attended elementary, middle, and high school with my mom or one of my aunts. I always performed at the top of my class, earning me the honor of being valedictorian of my high school class and a recipient of the Bill and Melinda Gates Millennium Scholarship. I attended the illustrious Spelman College for my undergraduate degree in chemistry, New York University for a master's in science education, and the University of Michigan for my doctoral degree in educational studies, where I am currently enrolled. The various opportunities afforded me to receive an education and have inspired my desire to offer similar opportunities to children who look like me.

I am an educator, a former high school science teacher. My former students from the Bronx make my heart smile and invigorate my drive to stay committed to the work of education. I prioritize their personalities, diversity, and well-being as I make decisions as an educator and researcher. They help me realize that every action I take can have felt consequences for students in classrooms right now. I currently serve as a district administrator contributing to the decision-making that guides a school district and even in this role, although the students are different, I remain student-centered in my work.

I am a trained chemist, although this identity is one that takes the background in most settings. I foreground this identity in this dissertation study and with the focal participants because my participation in the disciplines of science serve as representation, providing an example of a Black woman in science. Growing up I loved science. My Aunt Becky fostered my

scientific curiosity for the world through her work at Boonshoft Museum of Discovery. She would let my sister and I join her on weekends and during the summer. In addition to my colorful imagination, my childhood was also saturated with dissecting owl pellets; FIRST Lego League robotics competitions; "mad scientist" chemistry kits; district, state, and international science fairs; and engineering internships with aerospace engineers. I loved the creativity and problem-solving of it all and when it came time to choose an undergraduate major, science felt natural. Not until I received an internship at Breakthrough Atlanta, a college-preparation program for middle and high school students of color, did I shift my career goals away from science to education. I realized I wanted to nurture a similar passion for science within other youth. I had found what I felt I was meant to do!

My identities as a daughter, granddaughter, and niece combined with my identities as an educator, researcher, and scientist precipitated this dissertation study. Depending on the environment, whether I was at home with family, attending all Black schools, or traversing the white male dominated field of chemistry, I was grappling with being both noticed and unnoticed. I found myself navigating the omnivisibility of Black girlhood—the constant state of being simultaneously visible, invisible, and hypervisible in school and in society—while striving to maintain the joy and beauty of my childhood and young adult years. My experiences led me to design this study. I set out to understand what happens when Black girls and all their unique identities are able to exist in a science space that celebrates them and finds their contributions to the learning valuable.

Overview of Dissertation Study

In this study, I examine the ways Black girls express their imaginations in a critical, informal science learning program held virtually during the summer of 2020. I use portraiture

methodology (Lawrence-Lightfoot, 1995) to understand and present the ways that adolescent Black girls question the status quo, take critical stances against instances of unjust and inequitable treatment, and create change in spaces where their voices and experiences are often ignored and excluded. I offer a new conceptual frame, *Black girl imagination*, to investigate how Black girls' liminal identities produce a particular imagination that emerges when they are able to learn in a space that prioritizes their positive visibility. I use the term *Black girl imagination* to foreground the maintenance of Black girl *childhoodness*, the investment in Black girl *creativity*, and the legitimacy of Black girl *criticality* necessary to nurturing positive visibility. *Black girl imagination* centers the adolescence and innocence of Black girls, which is often stripped from them in schools, media, and even within Black communities. *Black girl imagination* is the dialogical relationship between Black girls' childhood abilities to be creative and to imagine and their abilities to be critical of the structures that shape the world around them.

I am offering Black girl imagination to the field of science education to argue that the unique imagination that Black girls possess due to their intersectional identities and life experiences can help educators develop more nuanced understandings of who Black girls are and how science education can be revolutionized to support their science learning. I argue that Black girl imagination is an innate quality that Black girls possess, but normative science learning environments stifle it. This dissertation probes what emerges about Black girls' learning and self-discovery when informal science curriculum is designed with nurturing Black girl imagination as its priority. I also consider what formal (in-school) science educators can learn about Black girls to develop restorative and empowering learning environments for them. To meet these goals, I designed and facilitated a virtual summer program, Empowering Girls Through Art & Science,

for rising tenth-grade girls that explored the histories of science from the perspective of Black girls and women and used artistic expression as a means of reflection to share learning.

This dissertation was guided by the following questions:

1. How do adolescent Black girls express their *Black girl imaginations* when participating in a critical, informal science learning space designed with them in mind?
2. What do their expressions of *Black girl imagination* reveal about their articulations of self?
3. What do their expressions of *Black girl imagination* reveal about their meaning making in science?

The data sources for this qualitative study include individual interviews, focus groups, student reflection videos, samples of students' art expressions, and research memos. I drew on these resources to produce narrative portraits of three of the girls who participated in the program.

Organization of Dissertation

The dissertation is organized into six chapters. This **introductory chapter** has detailed the background and rationale for the dissertation and offered an overview of the dissertation study design.

Chapter 2 provides a review of relevant literature to describe the current state of Black girls in U.S. schools and, specifically, in science learning spaces. I introduce the term *omnivisibility* to describe the predicament Black girls are tasked with navigating as they seek positive visibility in schools and society which position them as both invisible and hypervisible. I argue that the *omnivisibility* of Black girlhood in schools is also an obstacle to overcome for Black girls in K-12 science learning environments. Although there are few spaces that promote the positive visibility of Black girls in science, some such spaces have been cultivated by

Indigenous scholars for Indigenous youth in science and by Black feminist scholars for Black girls in literacy. I close with a discussion about these programs and how they provide a rationale for the creation of critical science learning spaces that center Black girls.

In **Chapter 3**, I offer a detailed discussion of my conceptual framework which (1) guided the development of the research context, Empowering Girls Through Art & Science; (2) informed the investigation of the girls' experiences in the program; and (3) I used to define what I am calling *Black girl imagination*. The conceptual framework is composed of three theoretical lenses that are intertwined to shape the curriculum design, study design, data analysis, and presentation of findings: Black girlhood studies (Butler, 2018; Evans-Winters, 2017; Smith, 2019), critical race theory in science education (King & Pringle, 2017; Mensah, 2018), and Afrofuturism (Morris, 2012; Womack, 2013). I conclude with a detailed discussion of Black girl imagination and how it shapes the study.

Chapter 4 comprises an account of the overall study design, including a description of the research methodology, portraiture; a description of the Empowering Girls Through Art & Science program; a discussion of the research methods; and an explanation of the data analysis methods.

In **Chapter 5**, I present three visual and narrative portraits of the focal participants, Chloe, Elaine, and Jordan, written to provide an overall representation of each girl while also attending to my three research questions. Offering creative presentation of the girls allows me to highlight and illustrate the childhoodness, creativity, and criticality that comprise their Black girl imaginations.

I conclude the dissertation with **Chapter 6**, in which I discuss the significance of nurturing Black girl imagination in science education. I discuss the implications of this study for

the development of science learning spaces and curriculum that center Black girls' childhoodness, creativity, and criticality.

Throughout the dissertation, I include a total of nine illustrations envisioned and created in collaboration with a former student of mine, Oscar Cargill, to offer artistic representations of the arguments and ideas shared. The images also serve the purpose of disrupting the norms of dissertation writing that can exclude creativity in the form of visual art. Three of the illustrations accompany the three portraits in Chapter 5, providing interpretive imagery of the girls and their presentations of self throughout their participation in the study. The other six are inserted throughout Chapter 2-4. May the illustrations encourage you to consider the complimentary duality of creativity and empiricism as you explore the dissertation.

What's Good Here?

I approached each aspect of this study by asking the question, "What is good here?" Lawrence-Lightfoot (1995) urges scholars, particularly those of us who are using portraiture as methodology, to approach research with communities of color in search of what is good, what is working well, what is strong and thriving and worthy. By taking this stance, we will first disrupt the legacy of focusing investigation on disease and pathology, and then we will be able to discover realities unrecognized by many, but which are worth learning more about. Lawrence-Lightfoot proclaimed that in entering research spaces with this mentality

> we may even uncover a lever for change, a spark of promise that had been formerly obscured by our well-worn negative prophecies. We must begin to see the resilience amidst the suffering, the agency that resists victimization. And when we find goodness in all of its fullness and complexity, we must invent ways of documenting and spreading it

so that the principles and lessons of goodness might be reinterpreted and embedded in other places.

Lawrence-Lightfoot teaches us that when we find the goodness we are looking for, we must share it with others to inspire how we approach research as a field.

I entered into this study to elevate Black girl voice and uncover narratives about Black girls that illuminate their beauty and brilliance from their own perspectives. My hope is that by elevating Black girl voice in this dissertation, the fields of science education take the brilliance and beauty of Black girls as axiomatic and begin to redefine the structures that currently guide the disciplines to move Black girls from the margins of science learning to the center.

May this dissertation serve as a celebration of Black girlhood, shining a spotlight on those who are currently adolescent Black girls and those to come. May we respect the diversity of your existence. May we acknowledge the innovation and change you bring to society. Simply, may we see you, as is, with no interruptions or alterations. May we see you. I see you.

Chapter 2
Literature Review

Figure 2-1 ***To Be Seen, Unseen, and Miss-seen.*** *This visual representation depicts the location of Black girls in U.S. schools, always navigation spaces of visibility, invisibility, and hypervisibility, depending on the environment and who is deemed the authority in that space.*

In this chapter, I review the theoretical and current empirical research base regarding the current state of Black girls in K-12 schools. I start here because many of the scholars (Love & Duncan, 2017; Gholson, 2016; Morris, 2016; Smith, 2016/2019) who seek to elevate research with and for Black girls draw on a similar theoretical and empirical orientation to Black girls' experience in U.S. education. Although the perspectives I take share much in common with these scholars, my argument differs from others in the field because I articulate "a constant state of *omnivisibility*" as central to understanding the state of Black girls in U.S. schools. I offer this term "*omnivisibility*" to capture the tensions Black girls endure as they are thrust into a paradoxical reality where they must navigate being invisible, hypervisible, and positively visible all at the same time. Simply by virtue of being Black girls in K-12 schools, they are forced to traverse the 13-year-long endemic challenge in which they must endure being eclipsed by the experiences of Black boys (Gholson, 2016; Noguera, 2003), not seeing Black girl/women represented in the teaching workforce and school curricula (Emdin, 2016; Jacobs, 2017), physical harm by adults in their schools (Carter Andrews, Brown, Castro, & Id-Deen, 2019; Epstein, Blake, & Gonza'lez, 2017), healing from school-incited spirit murder (Love, 2019), and the labor of having to advocate for themselves (Jacobs, 2017; Wing, 1997).

I begin this chapter by defining *omnivisibility*. I articulate the ways that schools are key contributors to Black girls' invisibility and hypervisibility, while Black families, teachers who acknowledge the beauty and brilliance of Black girls, and Black girls themselves, are sources of positive visibility inside and outside of school. Because my study focuses on Black girls in context, in the second half of this chapter, I discuss how Black girls are doing in secondary science learning environments, specifically. Although there has been a push in science, technology, engineering, and mathematics (STEM) fields, to increase Black girls' participation,

Black girls are still forced to navigate the *omnivisibility* of Black girlhood in science learning spaces. I end this chapter by identifying the paucity of science learning experiences that are designed to promote positive Black girl visibility. I then look to examples in science education with Indigenous youth and literacy education with Black girls for guiding principles for centering Black girls in science learning spaces. I use the theoretical and empirical research presented in this chapter to provide a rationale for why creating the learning context of Empowering Girls Through Art & Science, the context for this dissertation, was necessary.

Defining Omnivisibility

I constructed the term *omnivisibility* to describe Black girlhood in schools from my spiritual orientation and positioning as a Black woman scholar and educator. These identities are grounded in a fundamental sense of the omnipotence, omniscience, and omnipresence of God. My relationship with Jesus and the Christian faith inspires all that I do, particularly serving as a catalyst for the development of this study. This inspiration also served as a guiding framework to conceptualize and articulate how Black girls must navigate U.S. schooling. According to Google dictionary, "omni" means "all; of all things; in all ways or places." In alignment, biblical scripture describes God as *all* powerful and in control of *all* things (omnipotent). He is *all* knowing (omniscient) and is in *all* places at *all* times with *all* people (omnipresent).

Biblical scripture is drenched in parables, promises, and stories that elevate the omni-attributes of God. For example, Luke chapter 12 verse 7 reads, "And the very hairs on your head are all numbered. Fear not; you are of more value than many sparrows," signaling that God cares so much about us all that he knows everything about us including the number of hairs on our heads. He is omniscient. A widely known scripture, Genesis chapter one verse one, "In the beginning, God created the heavens and earth." In his power, he was able to speak the

spontaneous creation of the world into existence. He is omnipotent. Deuteronomy chapter 31 verse 8 reads, “It is the Lord who goes before you. He will be with you; he will not leave you or forsake you. Do not fear or be dismayed.” Here, scripture acknowledges God’s ability to be with you and to go before you in places you have yet to traverse. God is omnipresent.

These biblical texts point to the weight and vastness of the omni-attributes of God—a weight too heavy for any person to carry due to the limitations of our humanity. Still, Black girls are expected to bear a similar weight—that is, being able to do all things and meet the needs and expectations of all people (including themselves)—at all times. I use the term *omnivisibility* in this study to articulate the positioning of Black girls in schools and the labor required of them to constantly navigate among being seen, unseen, and mis-seen by school structures, the curricula taught, the adults in their lives, their peers, and themselves. Black girls exist in environments where they constantly bear the weight of being invisible to some, hypervisible to others, and positively visible to themselves all at the same time. What a burden to bear.

For example, a Black girl may come from a home that is steeped in Afrocentric ideology and Black pride where her family empowers her and gives her the tools to be agentic in the world (positive visibility). She may then enter a public school where she must learn from curricula devoid of accurate representations of Black people and people of color across subject areas and where she is pushed to the margins of advanced courses due to low expectations (invisibility). Simultaneously, she must also survive spaces where she is statistically likely to be the recipient of harsh disciplinary action by school staff based on stereotypes of who Black girls are and the discipline they “deserve” (hypervisibility).

Why are Black girls forced to endure such an all-consuming load--a load and capacity that only the God of the universe is meant to bear? I use the term omnivisibility to center the

weight and associated pain that Black girls must endure in efforts to thrive in U.S. schools and society. The omnivisibility of Black girlhood is always in flux, with Black girls navigating visibility, invisibility, and hypervisibility. Each of these states of visibility taking turns being foregrounded and backgrounded by those who teach, mentor, protect, love, and mis/understand Black girls. The omnivisibility of Black girlhood serves as a valuable lens to understand Black girls' experiences in U.S. schools and secondary science.

The State of Black Girls in U.S. Schools

U.S. schools are a microcosm of broader society. The racism, sexism, and exclusion based on socioeconomic status that run rampant in our country also infiltrates the schooling experiences of Black girls (Evans-Winter & Esposito, 2010). To disrupt the intersectional oppression experienced by Black girls in schools and society, teachers, administrators, and other school staff would have to work with intentionality. However, most commonly, Black girls are left on their own to navigate their positioning as both invisible and hypervisible. The positive visibility of Black girlhood despite the excessive invisibility and hypervisibility must not be overlooked. In the following sections, I describe the three states of the omnivisibility of Black girlhood in schools.

Black Girls Are Invisible

Black girls have been ignored and erased in U.S. schools. Educators and various stakeholders in the fields of education know very little about the experiences, hopes, and challenges of Black girls (Gholson, 2016; Ward & Robinson-Wood, 2006). Jacobs writes, "… Research and practice-based conversations about Black girls' educational experiences, trajectories, and outcomes still remain in the margins of focused policy work, programming, and pedagogical practices" (2017, p. 1). This lack of information contributes to a reality in which

teachers, administrators, and educational researchers overlook Black girls because they know very little about them; and because they know very little about Black girls, they are limited in their abilities and desires to advocate for them (Crenshaw, 2012; Gholson, 2016). The invisibility of Black girls is reinforced by (a) a focus on the well-being of Black boys that eclipses that of Black girls, (b) the myth that Black girls are doing just fine, and (c) schools' tendency to teach content devoid of any positive representations of Black girls and women.

Black Girls Are Eclipsed by the Experiences of Black Boys

Black girls' needs are persistently eclipsed by the overwhelming desire of certain educators, scholars, and activists to save Black boys. Black boys are considered to be "endangered" and have been deemed the most troubled demographic in our country (Noguera, 2008). This narrative has overtaken the field of education (Gholson, 2016; Noguera, 2003). Research and national, state, and local initiatives prioritize the protection of and investment in the lives of Black boys and men. The notion that Black boys are in crisis has been the center of research endeavors and knowledge production. Researchers theorize and identify best practices to help mitigate the vulnerability of Black boys in schools and in society (Carter Andrews, Brown, Castro, & Id-Deen, 2019; Gholson, 2016). Interventions such as former President Barack Obama's My Brother's Keeper initiative, Oakland's African American Male Achievement initiative, Save Our Black Boys Radio, and so many more have been developed to support our nation's "most vulnerable community," Black males. This hyperfocus on Black boys and men tends to exclude Black girls and women. As a result, little attention is paid to the ways that Black girls are also vulnerable and suffering (Carter Andrews, Brown, Castro, Id-Deen, 2019; Crenshaw, Ocen, & Nanda, 2015; Evans-Winter, 2017; Gholson, 2016). This attention to Black

boys' suffering is not unwarranted. However, it does contribute to systemically rendering Black girls as invisible in comparison to their Black male counterparts (Gholson, 2016; Jacobs, 2016).

The same data used to determine that Black boys are in need of support can be used to argue that Black girls too deserve to be seen and uplifted. Gholson (2016) describes the similarities between the lived experiences of Black boys and Black girls when she writes,

> Therefore, the educational challenges experienced by minority males have garnered the attention… however the minority girls who reside within the same educational communities and whose lives comprise the same statistical realities of poverty, crime, and poorly resourced schools have been essentially erased and treated with indifference… (Gholson, 2016, p. 294)

Black girls live in the same neighborhoods and attend the same schools as Black boys. Black girls are just as likely to be taught by the least trained teachers and just as likely to have limited access to quality instruction and relevant curricula (Crenshaw, 2015; Love, 2019; Graves, Kaufmann, & Frohlich, 2014). Although similar, Black boys and Black girls do not experience the world identically. Black girls must also traverse the intersectional marginalization resulting from race and gender oppression in schools and in society (Butler, 2018). Although well-intentioned, efforts to "save Black boys" have resulted in erasing the needs of Black girls, deeming them not as important and denying them access to the support they need and deserve to enhance their success in K-12 schooling.

Black Girls Are "Doing Fine"

Scholars argue that the lack of attention and care given to Black girls is a result of the myth that Black girls are actually doing just fine (Gholson, 2016; Jacobs, 2016; Ward & Robinson-Wood, 2006). Black girls are required to navigate learning spaces in which educators

make decisions and develop structures based on the myth that Black girls and women are doing well in school (Gholson, 2016; Ward & Robinson-Wood, 2006). This myth leads educators and other stakeholders to relegate Black girls to the margins where they receive little to no academic and social-emotional support. When looking at the overall statistical trends of Black girls' academic achievements and outcomes, they *do* supersede those of their Black male peers, which produces the fallacious belief that Black girls are "doing fine" in school (Jacobs, 2017, p. 2).

Black girls are actually not fine. When those same statistics are used to compare Black girls to their white female peers, we can see that Black girls are suffering. Black girls are twice as likely to be retained in grade than white girls and have less access to advanced level courses (Morris, 2016; Ross et al., 2012). Black girls' high school graduation rates are significantly lower than white girls' (Editorial Projects in Education, 2010). And, according to NAEP 2013 data, "63% of U.S. high school Black girls scored 'below Basic' in math and 39% of U.S. high school Black girls scored 'below Basic' in reading" (Jacobs, 2017, p. 3). Because on average, Black boys statistically perform lower than Black girls, their needs for support have superseded and erased the needs of Black girls in schools. In predominantly Black K-12 schools, Black girls are considered to be excelling, making them invisible and limiting their access to the interventions and resources they need.

Black Girls and Women Are Absent from School Curriculum

Not only are Black girls excluded from educational research and interventions, overshadowed by the experiences of Black boys, and operating within a false narrative that they are thriving in schools, they also are confronted daily by curricula that are devoid of positive representations of Black girls and women. Typical K-12 curricula in U.S. public schools has limited its inclusion of Black women and girls to the canonical figures of Harriet Tubman, Rosa

Parks, and the more recent sprinkling in of Michelle Obama (Jacobs, 2017). These representations are often relegated to U.S. history class or posted on a bulletin board once a year during Black History Month. The histories, contributions, and ways of knowing of Black girls and women are devalued and are invisible in school curricula. Research shows that students are more likely to be motivated to learn when the content is representative of their own lived realities (Emdin, 2016; Ladson-Billings, 1995). Despite this, current textbooks and other curriculum materials continue to be populated with photos and stories from the perspectives of white men. These one-sided histories often paint the picture of Black people as barbaric and Black women as domestic and oversexualized. Few efforts have been made to shift U.S. school curriculum in all content areas to include knowledge produced by and representative of Black people (for an example of what this could look like, see *Cultivating Genius* (Muhammad, 2020)).

Black girls develop positive self-esteem and can better relate to the curriculum when they see themselves in positive and non-stereotypical roles (Jacobs, 2017). Thus, this systemic lack of representation is likely to undermine Black girls' engagement in daily learning, contributing to overall poor performance in school. The invisibility of Black girls in U.S. schooling is alarming and calls for learning environments where Black girls are moved from the margins, centered, and deemed worthy of investment and care.

Black Girls Are Hypervisible

In addition to being invisible, Black girls are also hypervisible in U.S. schools. Black girls are overly policed, critiqued, and controlled by teachers, administrators, and school staff (Morris, 2016). As described in the previous section, Black girls are systemically rendered invisible in the various realms of education; but it is important to note that when Black girls *are* noticed, they are the recipients of harsher disciplinary actions, adultified at young ages, and

criminalized at alarming rates compared to their white counterparts (Camera, 2017; Epstein et al, 2017; Morris 2016 & 2018; U.S. News & World Report, 2017). The simultaneous state of being both invisible and hypervisible means the negligence of Black girls' well-being goes unnoticed and the severity of the harm caused to Black girls is minimized (Carter Andrews, Brown Castro, & Id-Deen, 2019). "The lack of data and attention paid to Black girls is causing us to overlook how they are increasingly becoming targets of excessive school disciplinary policies, sexual abuse and violence, and lack of access to quality mental health services" (Jacobs, 2017, p. 1). The hypervisibility of Black girls is evident in the disregard for and desire to control Black girls' bodies in schools and in the resulting spirit murder Black girls endure.

A Disregard for And Desire to Control Black Girls' Bodies

The hypervisibility of Black girls is a byproduct of the systematic disregard for and desire to control Black girls' behavior and their bodies in schools. Black girls are increasingly becoming targets of excessive school disciplinary policies and excessive force by those who are tasked to protect them while they learn (Morris, 2016). Although Black girls comprise less than 20% of the total U.S. female student population, they make up over 30% of female school-based arrests and 30% of law enforcement referrals by schools (Morris, 2016). Research shows that this criminalization of Black girls is pushing them out of school, lowering their graduation rates and post-secondary education attendance (Crenshaw, Ocen, & Nanda, 2015). Scholars have found that educators often use behavioral norms steeped in whiteness to determine whether or not Black girls' behavior is acceptable (Evans-Winters & Esposito, 2010; Jacobs 2017; Morris, 2007). Teachers expect Black girls to behave more "ladylike," defined as the behavior displayed by their white and Latina counterparts, instead of being "loud, defiant, and precocious" (Morris, 2007; Jacobs 2017). Educators often hold preconceived biases that automatically label Black

girls as in need of correction. This hyper-surveillance of what Black girls choose to do with their bodies leads to intense criticism and reprehensible lack of regard for their humanity.

For example, in South Carolina, in 2015, a school police officer used excessive force to remove 16-year-old Shakara from her desk. It is claimed that Shakara refused to put her cellphone away in class after being asked multiple times. In response, her teacher called the school police, and, after a brief conversation, the school security officer ripped Shakara from her desk, threw her across the room, tackled her, and arrested her. To reiterate, a grown man threw a child across the room because she refused to put her cellphone away. After reflecting on this horrific incident, I am left disturbed by the ease afforded to adults to dehumanize Black girls in classrooms and the lack of protection granted to them when they are clearly the victims of harm and violence.

Literature on Black girls and school discipline argues that there are strong connections between school discipline and the erasure of Black girls' childhoods (Carter Andrews, Brown, Castro, & Id-Deen, 2019; Epstein, Blake, & Gonza'lez, 2017). Black girls are not given the opportunity to simply be children. Instead, they are adultified at "almost all stages of childhood" (Epstein, Blake, & Gonza'lez, 2017, p. 8) and burdened with the expectation to behave as grown women. Black girls are perceived to need less nurturing, less protection, less comforting, and stereotyped to be more independent and knowledgeable about adult topics (e.g., sex) than other girls their age in other racial groups (Epstein, Blake, & Gonza'lez, 2017). Black girls are not allowed to make mistakes, although making mistakes is an innate part of the adolescent experience. Dixson argues that schools should recognize that Black girls' behavioral choices are not made out of defiance, but that "they are responding to an environment that doesn't help them feel free" (2016). The hypervisibility of Black girlhood centers Black girls to be the recipients of

school violence and excessive punishment, resulting in the denial of childhood innocence they are worthy of.

Black Girls Endure Spirit Murder in School

The hypervisibility of Black girls in schools has proven to be harmful to Black girls physically, but there are also spiritual repercussions. Black girls also experience spiritual harm, harm to the soul. As Bettina Love so passionately puts it, "schools are spirit-murdering our babies" (Love, 2019). Love describes this bruise to the soul that Black girls acquire in school as "a slow death, a death of the spirit, a death that is built on racism and intended to reduce, humiliate, and destroy people of color" (p. 6). Spirit-murdering is incited by anti-Black racism and white supremacy in classrooms, causing more than just physical pain (Love, 2019; Williams, 1987). It robs Black girls of their dignity and leaves them with emotional, psychological, and spiritual injuries (Love, 2019). Research has recently uncovered that school discipline is an instrument used for the spirit-murdering of Black girls (Carter Andrews, Brown, Castro, & Id-Deen, 2019; Hines & Wilmot, 2018). Hines & Wilmot (2018) found that there is direct correlation between a strong sense of spiritual defeat and (a) the over-representation of Black girls in self-contained classes where students are considered in need of hyper-surveillance and policing; (b) the over-classification of Black girls as being emotionally disturbed, which is often misunderstood as defiance in need of harsh redirection; and (c) the higher rates of Black girls receiving out-of-school suspension. The death of Black girls' spirits can confine their minds and souls to lifelong captivity even when there are no literal bars present (Hines & Wilmot, 2018).

The images painted of Black girls in media that portray them as aggressive, insubordinate, hypersexualized, and uncontrollable saturate the perceptions that educators have of Black girls in schools. These perceptions then fuel the development of "classroom-based jail

cells that are designed to spirit-murder Black girl freedom, Black girl magic, and Black girl joy" (Hines & Wilmot, 2018, p. 63). Spirit-murdering is one of many repercussions Black girls experience due to anti-Blackness, over-policing of Black bodies, and the maintenance of whiteness during their schooling experiences. They are required to sift through these experiences and find ways to still show up to schools daily, focus on their academic well-being, and center joy, laughter, and friendship.

Black Girls Are Visible

Although Black girls are given the unfair task to navigate invisibility and hypervisibility in schools, positive representations of Black girls surrounding their educational experiences do exist. Black girls experience positive visibility—the act of being authentically recognized, cared for, accepted, and invested in without any requirement for change or alteration—in schools and in society due to their own acts of resistance. Black girls stand up for what they believe in, deciding when to use their voices to push back on the systems that seek to position them as invisible or hypervisible. Scholars articulate the visibility of Black girls in school as being attributed to (1) Black girls seeking visibility for themselves through dual personas, (2) Black girls being products of strong Black families, and (3) Black girls experiencing Dream-keepers as teachers.

Black Girls Seek Visibility for Themselves Through Dual Personas

Evans-Winter & Esposito (2010) argue that Black girls survive the harm endemic to U.S. education due to their ability to traverse school, their communities, and society with dual personas. Black girls "practice silence as a strategy for getting ahead in class, but also [practice] strategies of 'talking back' to speak out against classroom discourse and practices that [are] not necessarily viewed by them to be in [their own] best interest" (Evans-Winter & Esposito, 2010,

p. 13). Henry (1998) theorizes about Black girls' duality in her study of African American girls attending an African-centered school. She posits that Black girls' abilities to operate across a dual persona, choosing when to speak up and when not to, is an act of resistance and results in a resilience inside and outside of school.

Black girls' ability to navigate schooling from a dual persona is birthed from a multiple consciousness that Wing (1997) argues all Black girls and women possess. Evans-Winter and Esposito (2010) describe this multiple consciousness as the ability to "hold on to their own beliefs and values, while also being aware and conscious of the state of mind of the oppressor" (p. 13). Because of the layers of gender, race, sexuality, religion, class, and age that make up Black girls' liminal identities, this multiple consciousness is learned and adopted to survive in a racist patriarchal society (Evans-Winter & Esposito, 2010; Wing, 1997). Black girls are visible in schools because they are intentional about when and when not to use their voices, both choices being acts of resistance.

When Black girls choose to use their voices to push back on institutions designed to marginalize them, they often are seeking visibility not only for themselves but advocating for the visibility of other Black girls and boys. Dana Wilson, a youth activist from Detroit, Michigan, was filmed using her voice to denounce Betsy Devos' nomination for U.S. Secretary of Education in 2017. Dana stood proudly wearing a t-shirt that read "I stand for Education Justice" and said to the crowd:

> Good afternoon, everyone! My name is Dana Wilson. I am a student in the city of Detroit, and on Martin Luther King Day 119 parents, organizers, students travelled from Detroit to attend Betsy Devos' hearing. Running on three hours of sleep, we waited in line. Mrs. Devos, I waited to listen to you for seven hours. Now is your time to listen to

> me (crowd applauds). Last night you said you were a visual learner, which is perfect because I'm an artist. Let me paint you a picture, a picture that explains what you've done to me, to my family, and to my peers in Detroit. Throughout my middle and high school careers, I've always been the poster child, but I've also been in oversized classrooms with outdated textbooks. I've been a victim of principal turnovers. My parents drive 165 miles *a week* for "quality education."

Full of conviction and authenticity, Dana continued to share her experience as a Black student in Detroit, choosing to make herself visible in pursuit of better educational experiences for herself, her siblings, and other Black and Brown students in her city. Black girls like Dana, are "using their voices to critically analyze and respond to encounters of injustice, discrimination, and oppression" (Jacobs, 2017, p. 7) in their communities and their schools.

Black Girls Are Products of Strong Black Families

Black girls are made visible by their families and seek visibility for themselves because of strong familial upbringings. O'Connor (1997) posits that the Black girls who are the most academically resilient are socialized by their families to have strong senses of racial identification and a recognition of their own agency to fight against injustice. The adolescents who participated in O'Connor's (1997) study articulated the ways that their significant others were explicit about the dominant and oppressive nature of whiteness but were also just as intentional in the ways they affirmed their rights and liberties as Black Americans (O'Connor, 1997). Building on O'Connor's (1997) earlier work, Evans-Winters and Esposito (2010) argue that Black girls "whose families not only taught them about race, class, and gender oppression, but also participated in family conversations that explained to them how to combat racist, classist and sexist forces" (p. 12) were most resilient in school.

Black families lead by example, advocating for their children when they experience racial discrimination in school and instilling in them that "institutions which reflect or contribute to inequality need not be abandoned but must be engaged (through conflict and opposition if necessary) in order to produce positive change" (O'Connor, 1997, p. 623). In many Black homes (from various socio-economic statuses), families seek to be "seen" rightfully by others in society. Learning from their families to demand visibility enables Black girls to have the confidence and self-assuredness required to seek visibility for themselves in school.

Black Girls Experience Dream-keepers as Teachers

As described above, teachers have a significant impact on students' schooling experiences. Not only can teachers contribute to the criminalization and adultification (i.e., hypervisibility) of Black girls in schools, but they can also be the sources of celebrating the beauty and brilliance of Black girls. In some cases, Black girls participate in educational experiences with teachers who believe they are capable of excellence, recognize the importance of community, see their own and their students' race and culture as integral to teaching and learning, and find ways to weave Black cultural knowledge into the curriculum (Ladson-Billings, 2009). Ladson-Billings describes teachers who provide such experiences as Dream-keepers. Teachers who are Dream-keepers recognize the influence that race, culture, and lived experiences have on students' existence and performance in schools. Though not necessarily Black themselves, they cultivate spaces for Black children to choose academic excellence and cultural expression that is integral to their lived realities.

Greshenson et al. (2018) further explore teachers' impact on Black girls by looking at Black girls' experiences with same-race teachers. Gershenson et al.'s (2018) study explores the impact that same-race teachers have on students' educational longevity. The authors find that

Black students who are taught by supportive Black teachers in grades K-3 are 7% more likely to graduate high school and 13% more likely to attend college when compared to Black students who were not taught by Black teachers (Gershenson et al., 2018). They attribute these long-term effects to (1) Black teachers in their study, on average, having more years of teaching experience than their white counterparts; (2) Black teachers serving as culturally relevant role models to their students; and (3) Black teachers having the ability to use their cultural competence to employ culturally relevant pedagogies (Ladson-Billings, 1995) and teach the hidden curricula (Foster, 1990), which is often ignored by non-Black educators. Black girls' visibility is elevated by teachers, some Black and others non-Black, who believe in them and their academic success.

Summary

Black girls' educational experiences require a particular labor and resilience that no other subgroup of students has to endure. Because of the lack of regard for their well-being by school staff and the structures that control U.S. schooling, Black girls have been shoved so far to the periphery that they are the recipients of great harm academically, physically, and spiritually. Black girls must simultaneously navigate being overlooked, overly criticized, and celebrated. Although unfair, in their demand for positive visibility, many Black girls stand firmly in their agency requiring equitable educational experiences where their needs are elevated and met.

Black girls bear the burden of battling omnivisibility throughout their K-12 schooling experiences and beyond. In the next section, I present empirical and theoretical arguments that demonstrate the ways Black girls traverse a similar omnivisibility in secondary science to provide a rationale for why creating the learning context of Empowering Girls Through Art & Science was critical to promote Black girl visibility in science.

Cracks, Shadows, and Outsiders Within: Locating Black Girls in Science Education

Normative science learning environments are not immune to the alarming realities described in the previous sections. Science classrooms are situated within U.S. schools, therefore Black girls must navigate being simultaneously invisible, hypervisible, and positively visible in science learning spaces as well. Additionally, the disciplines of science and how they are taught in U.S. schools adhere to Western epistemologies and ontologies, which are steeped in whiteness. The omnivisibility of Black girlhood in science is a result of many things. The innate racist and sexist nature of the science disciplines make it difficult for Black girls to fully engage. Another factor is educators' and researchers' lack of knowledge of who Black girls are and the relationships they have with science inside and outside of school (Jacobs, 2017). Learning about the ways Black girls engage with science has seldom been the focus of science education research, resulting in heightened invisibility of Black girls, where they occupy the margins of science-specific interventions and high-quality learning.

The literature clearly identifies Black girls' interest in science, technology, engineering, and mathematics (STEM) (Evans-Winters, 2017; Malcolm, Hall, & Brown, 1976; Rayman & Brett, 1995; Vining-Brown, 1994). Although Black girls are interested in STEM, they often feel unwelcome and experience racism and sexism in their classes, pushing them to occupy marginal spaces in U.S. STEM classrooms (Carlone, Johnson, & Scott, 2014). Carlone, Johnson, and Scott (2014) describe the spaces that girls (and Black girls) occupy in science as cracks and fissures, and narrow passageways that girls are relegated to occupy due to the incongruence between their intersectional identities and the normative, Western identities that dominate the fields of science. Gholson (2016) argues that Black girls are "lurk[ing] in the proverbial shadows of inquiry in mathematics [and science] education …becom[ing] visible only briefly to illuminate the status of

Black boys and men or White girls and women" (p. 298). Moses & Cobb (2002) refer to these spaces occupied by Black girls in science as crawl spaces, while Collins (1999) theorizes about Black women and girls as "the outsider[s] within" (p. 86). In most cases, scholars have argued that Black girls are rendered invisible and are shoved to the periphery of science learning spaces, which are overflowing with "exclusion, mis-opportunities, and 'under-education'" (Farinde & Lewis, 2012, p. 421).

Scholars identify one cause of Black girls' persistent invisibility in science learning spaces as the perpetual denial of access to robust science learning due to intersectional race, gender, and class oppression (Gholson, 2016; Jacobs, 2017; King, 2017). Little empirical research has been conducted to understand the ways that the dual presence of race and gender affect the educational experiences of Black girls (Farinde & Lewis, 2012). Instead, inquiry has addressed gender and race in isolation (Catsambis, 1994; Farinde & Lewis, 2012; Gholson, 2016), leaving the truths about Black girls' experiences at the intersection of race and gender in science classrooms vague and misunderstood. Here, I unpack ways that Black girls are denied access to high-quality science learning, rendering them invisible in science classrooms. Then I discuss possible spaces for Black girls to become positively visible in science.

Black Girls are Denied Access to High-Quality Science Education

Black girls are perpetually denied access to high-quality science learning experiences in U.S. schools (Gholson, 2016; Jacobs, 2017; King, 2017), which creates a pattern of underrepresentation of Black girls and women who pursue degrees and careers in STEM (Farinde & Lewis, 2012; Price, 2010). In 2012, the White House Initiative on Educational Excellence for African Americans showed that 11.2% of all bachelor's degrees in science and engineering were attained by minoritized women. In addition, minoritized women made up 8.2%

of master's degrees and 4.1% of doctorate degrees earned in science and engineering, with Black women making up an even smaller percentage of this demographic. There have been few out-of-school programs developed to enhance Black girls' exposure to STEM fields, and the barriers in K-12 schooling remain enormous hurdles for them to overcome (Joseph, 2020).

Systemic structures including district and school-wide policies exclude Black girls from science learning opportunities. Schooling structures that govern who have access to advanced, honors, and rigorous STEM classes keep Black girls and women invisible and in the shadows (Graves, Kaufmann, & Frohlich, 2014). Literature suggests that Black girls also encounter structural denial where they are often advised by school staff not to enroll in advanced or honors STEM classes (Gholson, 2016; Graves, Kaufmann, & Frohlich, 2014). As a result, "students who do not enroll in advanced courses… in high school choose STEM careers at much lower rates than those that do enroll" (Collins, Joseph, & Ford, 2020). Not only are they counseled out of these courses, but many schools that serve disproportionately more students of color, including Black girls, do not even offer advanced courses in their schools (Collins, Joseph, & Ford, 2020; Gholson, 2016; U.S. Department of Education, Office of Civil Rights Data Collection, 2014). The mathematics and science courses that are offered are often taught by under-educated and unqualified teachers (Darling-Hammond, 2013; Gholson, 2016; King, 2017). These barriers are institutional and are motivated by systemic patterns of discrimination and stereotypical images of science doers, who are typically white and male (Farinde & Lewis, 2012). How can the gap in Black girls' access to STEM careers be mitigated if the learning opportunities for them in K-12 settings are absent, insufficient, or limited at best? How can Black girls be encouraged to pursue STEM degrees when the barriers in K-12 schools are deeply rooted and extremely hard to overcome?

A lack of courses and qualified teachers to teach science in K-12 spaces are not the only barriers obstructing Black girls' progress in STEM. Feminist scholars argue that typical science activities are often incongruent with how girls express and experience their gendered identities (Brickhouse & Potter, 2001; Eisenhart & Finkel, 1998). I argue that in addition to the activities being incongruent with gendered identities, they are also incongruent with Black girls' racial identities, making typical science activities intersectionally incongruent with Black girls' lived realities. Textbook pages tout images of stereotypical depictions of scientists (Farinde & Lewis, 2012), most of which are of older white men, wearing lab coats and bifocals, constructing experiments in traditional laboratories. Curriculum is often devoid of any mention of the contributions, capabilities, and/or histories of Black women (and Black people more broadly) (Farinde & Lewis, 2012), making the content culturally alienating and unrelatable. Black girls are relegated to occupying the margins, cracks and fissures, and the shadows of science education, where they are practically invisible to educators and researchers. The systemic and structural denial Black girls encounter in science learning spaces requires intentionality to create spaces of visibility for them. These spaces will not simply emerge naturally because of the patterns that show that Black girls are statistically marginalized in science education.

Spaces of Visibility for Black Girls in Science

Although it has been made clear that Black girls are located in the cracks, shadows, and outskirts of science learning in U.S. classrooms, Black women educators and industry professionals are working to construct spaces of visibility and pipelines for Black girls to have positive experiences in STEM spaces. There are a few programs that have been created to support Black girls' visibility in STEM learning spaces, including Black Girls Do STEM, BlackGirlsCode, and the Black Girls Create Project. All three programs were founded by Black

women—Cynthia Chapple (Black Girls Do STEM), Kimberly Bryant (BlackGirlsCode), and LaShawnda Lindsay (Black Girls Create Project)—and differ in curricular focus; but they align in centering Black girls and their exposure to STEM topics and skills. Each program has an explicit mission to provide opportunities for Black girls to learn, create, and build confidence around their participation in STEM.

The Black Girls Create Project stands out because of its unique commitment to being culturally responsive, "providing a curriculum and a learning environment that incorporates girls' cultural and intellectual histories and expands the meaning and purposes of STEM learning" (Lindsay, 2021, p. 41). In this after school maker space, Black girls design, tinker with, and build artifacts. They learn about Black women's contributions to STEM and develop transferable STEM skills through design and digital fabrication. Lindsay (2021) argues that the culturally relevant nature of Black Girls Create Project addresses the participation gap Black girls face in STEM and leads to participants having more positive racial and gendered identities at the conclusion of the program. There are spaces that center Black girls' positive visibility in science. Some that are committed to centering intersectionally congruent learning opportunities for Black girls that decenter whiteness, and others that seek to prepare Black girls with skills needed to survive the exclusionary nature of Western science spaces steeped in whiteness. Black Girls Create, BlackGirlsCode, and Black Girls Do STEM are not the only programs designed for Black girls by Black women to promote access to rigorous STEM learning, but research on these programs is scarce. There is a need for more spaces that are designed to nurture Black girls' visibility in science.

Learning From Those Cultivating Spaces of Visibility for Indigenous Youth in Science & Black Girls in Literacy

Although spaces that promote the visibility of Black girls in science are scarce in science education research, similar spaces have been created with and for Indigenous youth to explore science through multiple ways of knowing (Bang & Medin, 2010). Similar spaces have also been cultivated by Black feminist scholars in literacy education to promote Black girl visibility through liberatory reading and writing (Muhammad, 2012). In this section, I explore the studies of these programs to further provide rationale for the creation of critical science learning spaces that center Black girls.

Visibility of Indigenous Youth in Science

In their study with Indigenous youth, Bang & Medin (2010) explore the ways youth respond to culturally relevant science curricula. The authors implemented a three-week community-based summer science program designed to support Indigenous students' visibility in science. The program was specifically intended to support their navigation between typical school science and science that aligns with their cultural ways of knowing outside of school. The curriculum sought to explicitly promote the use of Native epistemological orientations in science—ways of knowing steeped in historical and cultural identity, relationship with nature, and culturally rich scientific practices. As the youth engaged in the curriculum, Bang and Medin found that students began to recognize themselves and others in their communities as science doers. They also came to acknowledge their communities as places where science takes place, even though the science in their communities differed from the science explored in school. By the end of the program, students were more willing to endorse the statement, "My tribe has been doing science for a long time" (Bang & Medin, 2010, p.1021). They began to see science as a historical and cultural endeavor done by Native people. There was a shift in recognizing

science knowledge as not solely Eurocentric, Western ideas, but also as knowledge derived in Native communities. Through this three-week program the authors helped to elevate the visibility of Indigenous youth using a curriculum that centered epistemological orientations that were culturally relevant to students. Visibility, in this case, included disrupting the narrative that science learning and doing are reserved for those who are White and male. It also required shifting from a focus on how well these children perform in STEM learning spaces to what opportunities they receive to think critically about STEM content as it relates to their own lived experiences.

Visibility of Black Girls in Literacy

Scholars are developing and studying programs in literacy education that elevate the visibility of Black girls. Muhammad (2012), a Black woman scholar, conducted a study with 16 adolescent Black girls in a five-week after school writing institute, Write it Out! The institute was grounded in identity, resiliency, solidarity, and advocacy. The goal was to provide room for the girls to tell their own stories in their own voices through writing. Muhammad posited that these experiences enabled Black girls to escape and feel a sense of liberation from the limitations associated with writing in school, arguing that "teachers can create a safe space where Black adolescent girls can openly and unapologetically express themselves" (p. 210). She found that the girls described the institute as a place they could let down the facade they were forced to uphold in traditional classroom spaces to meet the standards of being a "good" writer. They expressed that the institute made them feel affirmed in themselves and clearly acknowledged that this was because the institute differed greatly from their literacy experiences in school.

Takeaways

Black Girls Create Program, the science program for Indigenous youth, and Write it Out! reveal the power and promise of programs that are designed for youth of a community by adults in their community to enable opportunities for youth to feel seen and to thrive. Each of these programs made intentional efforts to center the children they serve by backgrounding the typical measures of success in their disciplines to elevate cultural knowledge and personal expression. Each of the example programs took place in out-of-school settings, offering opportunities for program designers and facilitators to deviate from systems and structures (e.g., standards, assessments, grades, etc.) that greatly contribute to the exclusion of these students and their lived realities in schools. These programs were built on the foundation defined by youth visibility, and all curricular decisions were made to uphold that foundational priority. U.S. schools are built on a foundation that marginalizes, excludes, and renders groups of students who are not white and male both invisible and hypervisible, which makes out-of-school, informal learning environments ripe for disrupting dominant and oppressive schooling structures.

Scholars argue that one approach to making science more accessible is through the implementation of informal science learning programs (King, 2017; Dorsen, Carlson, & Goodyear, 2006). In particular, this approach can offer alternative routes for Black girls to engage in science learning that is rigorous and relevant to their lives. These informal science learning spaces can elevate Black girls' visibility while they navigate invisibility and hypervisibility in formal K-12 schooling. Not only does the theoretical and empirical research base presented in this chapter support the need to develop a positive learning space for Black girls, but it also specifically points to the need for such a program to exist outside of the walls and constraints of U.S. schooling.

Summary

Black girls are required to navigate the omnivisibility of Black girlhood in U.S. schools, an incredible weight that only the God of the universe should have to bear. Black girls traverse K-12 schooling, experiencing invisibility in learning and hypervisibility in discipline, while also experiencing moments of visibility in their homes, with Dream-keeper teachers, and within themselves. As the literature reveals, there is a lack of science learning spaces that are designed specifically to promote Black girl visibility in U.S. schools—spaces where Black girls can freely express themselves, engage in a curriculum relevant to their intersectional identities, and experience learning with a highly-qualified Black teacher. Critical for Black girls in science are spaces where they do not have to contend with the marginalization, harm, and misrepresentation endemic to U.S. schooling. The theoretical and empirical base presented in this chapter provided the foundation for creating Empowering Girls Through Art & Science, a critical informal science learning space designed to center Black girls' positive visibility and their ways of knowing and being. This setting is the context for this study.

Chapter 3
Conceptual Framework

This dissertation seeks to learn about Black girls' articulations of self and meaning making when they are engaged in an informal science program that prioritizes the positive visibility of Black girls, promotes the critical exploration of scientific histories, and seeks to nurture *Black girl imagination*. This chapter has a dual purpose. First, I describe the conceptual framework I used as the blueprint for the development of the program, Empowering Girls Through Art & Science, and the lens that guided my investigation of the girls' experiences in the program. Second, I use the conceptual framework to define what I am calling *Black girl imagination*. I argue that *Black girl imagination* is always present, but the constant battle to overcome invisibility and hypervisibility in schools can stifle its emergence in science learning spaces. I present key features to consider when creating a program that nurtures Black girl visibility and is able to identify the emergence of *Black girl imagination* in a science learning space.

I describe the three theoretical lenses that I intertwined to shape the curriculum design, study design, data analysis, and presentation of findings: Black girlhood studies (Butler, 2018; Evans-Winters, 2017; Smith, 2019), critical race theory in science education (King & Pringle, 2019; Mensah, 2018), and Afrofuturism (Morris, 2012; Womack, 2013). I then define *Black girl imagination*. Finally, I discuss how my theoretical lenses and the concept of *Black girl imagination* inform this dissertation study. I begin by describing the most foundational of the three, Black girlhood studies. Black girlhood studies set the foundation for how Black girls are

positioned and cared for throughout this study. Table 3-1 visually represents the organization of this chapter and how the three theoretical lenses work together to define Black girl imagination.

Table 3-1

Conceptual Framework as Blueprint, Lens, and Definition

Framework used to (1) decide what happens in the program (blueprint) (2) identify and understand what takes place during the program (lens) (3) define Black girl imagination in science learning (definition)		
Descriptive and Interrogatory		Aspirational
Black Girlhood Studies	Critical Race-informed Science Education	Afrofuturism
1. Black girls' experiences are distinct from those of Black women 2. Black girls have been denied the right to childhood 3. Black girls possess creative capacities that inspire change 4. Black girls view the world through a lens of criticality	1. Revolutionize curricula, standards, policies, and conversations around science to explicitly address issues of race, whiteness, white supremacy, anti-Blackness, and intersectional exclusion within science learning spaces. 2. Prioritize the histories of science to center the contributions of People of Color (with particular attention to Black women) and the ways science has harmed, erased, or taken advantage of them. 3. Reckon with the disregard for the ethical obligations of science and scientists. 4. Develop new culturally relevant learning contexts that allows space for students to navigate across various epistemologies of science and to learn about science exploration in other cultures outside of modern Western science. 5. Dismantle structures and barriers that push Black, Indigenous, and other students of color to the periphery of science learning spaces.	1. Science fiction expands what is considered scientific inquiry 2. Past, present, and future are interwoven, foregrounding the necessity of history and future when seeking to exist in the present 3. The Black imagination has liberatory power
Black Girl Imagination (in science) *Childhoodness, Criticality, Creativity*		

Figure 3-1: ***I Am Because You Were.*** *This visual representation depicts the foundational role Black feminist thought has played in the theoretical underpinnings of Black girlhood studies. Although Black feminism is a necessary precursor for the existence of the field of Black girlhood studies, it is important to not allow the memory of one's childhood to eclipse that of those who are experience childhoodness contemporaneously.*

Black girls, across time, in all their beauty, brilliance, and diversity occupy unique intersections of race, age, gender identities and expressions, sexuality, and socioeconomic status (Smith, 2019). The field of Black girlhood studies was developed to pay special attention to Black girls' lived realities and ways of knowing during their adolescent years. I use the field of Black girlhood studies to acknowledge the particular intersections that Black girls occupy, choosing to pay particular attention to the intersectional experiences of the Black girls in this study who existed as adolescents in the eventful year of 2020. Black girlhood studies present a theoretical space to explore the "multifaceted and complex realities of Black girlhoods in an effort to offer Black girls the power and agency to claim, create, and develop their own self-definitions" (Smith, 2019, p. 21). The field has its origins in Black feminist thought, the prolific ideological movement that continues to deem Black women worthy of being at the center of understanding, resistance, and liberation (Hill Collins, 2000).

Those who study Black girls often find themselves knee-deep in Black feminism in hopes that a better understanding of Black women will yield a better understanding of Black girls. However, this is not always the case. In this section, I begin by offering a brief exploration of Black feminist thought. I follow this exploration by differentiating Black girlhood studies from Black feminist thought, identifying the associated dangers and limitations of conflating the two. I argue that making the transition from using Black feminist thought in isolation to the inclusion of Black girlhood studies offers a tailored lens, which illuminates the denial of childhood Black girls experience, the creative capacities that Black girls possess, and Black girls' abilities to be critical of the world around them. I end by describing how Black girlhood studies enables me to more fully understand the three Black girls portrayed in this study.

Black Feminist Thought: The Historical Underpinning of Black Girlhood Studies

Prior to the formal development of the Black feminist movement, Black women's liberation sat uneasily at the crossroads of two movements: the (white) feminist movement and the Black liberation movement. Each of these proved inadequate to the task of seeking equity and justice for Black women, as they were neither white enough for mainstream feminism nor male enough for the patriarchal structures and concerns of Black liberation (Taylor, 1998). Black women were neither white enough for feminism nor male enough to benefit from the pursuits of Black equality. The interrelationship of white supremacy and male superiority together precipitated Black women's struggle— "a struggle to survive in two contradictory worlds simultaneously, one white, privileged, and oppressive, the other Black, exploited, and oppressed" (Cannon & Russell, 1985, p. 30). Black feminist thought was codified to materialize Black women's oppression and struggle as distinct from that of white women and Black men by conceptualizing their experiences at the intersections of race, gender, sexuality, and class inequities (Hill Collins, 2009).

Hill Collins (2009) identifies four major themes that undergird Black feminist thought. The first theme elevates the ability Black women possess to empower ourselves, define ourselves, and evaluate ourselves, which allows for the creation of authentic, diverse images of Black womanhood. Simultaneously, Black women's empowerment allows us to also deny the negative, controlling representations of Black womanhood perpetuated in society. The second theme is the commitment Black women have to dismantling systemic, interlocked structures of race, class, and gender oppression. Black feminist thought is explicit in naming and describing the intersectional oppression that Black women traverse and how Black women have been demanding equity in those intersectional spaces for generations. The third theme is Black

women's ability to intricately intertwine intellectual thought, lived experience, and political activism. The fourth theme recognizes the historical lineage that Black women are a part of, which produces the tenacity and skills needed to resist and transform daily discrimination.

The themes presented by Hill Collins (2009) acknowledge that Black women have and continue to exist at the epicenter of unique forms of violence, discrimination, and marginalization, yet at the same time are the sources of light and force pushing the movement for Black racial justice forward. Black feminist thought elevates the tension between oppression and resistance that Black women have grappled with and reveals the powerful position Black women have occupied as caretakers and leaders of the Black liberation movement. There is a duality innate to Black womanhood: on the one hand, the ongoing oppression Black women experience in the U.S.; on the other hand, Black women's intense pursuit of political empowerment and leadership in community organizing (Hill Collins, 2009). Black women can be found spearheading movements for racial justice and fighting for equity and freedom for Black men, women, and children. McKay (1992) describes this duality as a forced choice between foregrounding their Blackness or foregrounding their womanhood:

> In all their lives in America … Black women have felt caught between the loyalties that bind them to race on one hand, and sex on the other. Choosing one or the other, of course means taking sides against the self, yet they have almost always chosen race over the other: a sacrifice of their self-hood as women and of full humanity, in favour of the race. (McKay, 1992, p. 277-278, quoted in Hill Collins, 2009, p. 132)

In other words, Black women consistently choose to show up for Black men and Black children over showing up for their full selves.

Black feminist thought is the epitome of praxis, existing in both the metaphoric and theoretical worlds while also being tangible and experiential. Black feminist thought "involves discovering, reinterpreting, and in many cases, analyzing," the lived experiences of Black women to theorize about the everyday struggles and triumphs of Black womanhood (Hill Collins, 2009, p.13). Black feminist thought comes alive in stanzas of spoken word poetry, on the pages of fictional literature, on platforms and stages, on front porches, at kitchen tables, in beauty salons, and in the intellectual labor associated with inventions, transformative ideas, and progress for liberation. Black womanhood is diverse and has existed across time, from generation to generation, being expressed in various ways. The complexity of Black womanhood echoes in the souls of our ancestors who thrived prior to the transatlantic slave trade and reaches far into the future. Black feminist thought articulates the experiences of Black women to be dynamic and ever evolving. It has paved the way for scholars to begin theorizing about the experiences of Black women prior to adulthood, during their adolescent years.

Centering Childhood: From Black Feminist Thought to Black Girlhood Studies

Because many Black women were once Black girls (Ransom, 2021), Black feminist scholars have taken the deeply researched and conceptualized complexities of Black womanhood and applied Black feminist thought to explore the experiences of Black girls (Crenshaw 2015; Hill Collins; 2000; hooks, 2003). However, scholars within the field of Black girlhood studies (Evans-Winters, 2017; Halliday, 2019; Smith, 2019) argue that using Black feminist thought in isolation can result in "over-essentialized and homogenized descriptions of Black girls' experiences" (Smith, 2019, p. 4). There is also the risk of perpetuating the adultification of Black girls when comparing their lived realities to those of adult women. Further, using Black feminism as a singular lens to explore Black girlhood can result in unintentionally erasing and

replacing Black girls' childhood experiences with Black women's memories of their own childhoods (Smith, 2019). Black girlhood studies pivot from a singular reliance on Black feminist thought to enable research with and for Black girls that allows them to tell their own stories from their liminal perspectives. Black girlhood studies clearly outline the ways that (1) adolescent Black girls' experiences are distinct from those of Black women, (2) Black girls are denied childhood, (3) Black girls possess creative capacities, and (4) Black girls view the world through a lens of criticality.

Black Girls' Experiences Are Distinct from Those of Black Women

Although often conflated, current adolescent Black girls and Black women (who were once Black girls) have distinct experiences in the world. In addition to the intersectional realities associated with their race, gender expressions, sexuality, and class identities, Black girls' experiences are also defined by their age, cognitive development, generational affiliations, access to and understanding of technology, and the geopolitical and sociopolitical locations that surround their existences (Butler, 2018). The intersections of their identities and the contexts in which they express those identities are critical components of what defines childhood for Black girls.

Butler (2018), a scholar of Black girlhood studies, describes geopolitical locations as "places that are created through laws, ordinances, and zoning codes" and that are defined by "rezoning laws, unemployment, as well as racial and class discrimination in the housing industry" (p. 31). These locations "compound the social inequities" that Black girls experience. They comprise the context in which Black girls learn, play, love, live, and develop spaces for themselves. In addition to physical spaces like neighborhoods, community centers, and schools, Butler also acknowledges that these locations can also be theoretical, intellectual spaces with the

power to exclude, harm, and disenfranchise. The geopolitical locations occupied by current Black girls are experienced differently than Black women and depending on generational affiliation, may look vastly different. Imagine being a Black girl prior to the Great Migration. The geopolitical location surrounding Black girlhood in that era was characterized by the Jim Crow South. Black girls during 2020 who are descendants of those who migrated north, experience society differently as they still navigate racism and sexism along with the intricacies of social media, the aftermath of the first Black President of the United States, and the Black Lives Matter movement.

Black girlhood studies argues that because Black girls' liminality is distinct from Black women's, we must listen to Black girls as they are experiencing Black girlhood to better understand the complexities and the ebbs and flows of their lived realities. In addition, both physical and epistemological spaces must be created for Black girls with Black girls that are relevant to their unique identities (Butler, 2018). In these spaces, Black girl narratives and voices are uplifted, promoting lives full of joy despite the persistent harm they may experience in school and society (Smith, 2019).

Black Girls Have Been Denied Childhood

If scholars who seek to elevate the voices and experiences of Black girls do not learn from Black girls as they are experiencing Black girlhood, we may be perpetuating the historical denial of childhood that Black girls have been forced to experience for centuries in the U.S. Black girls have been "stripped of any element of childish naivete" (Ferguson, 2000, 589) due to the invisibility and hypervisibility experienced in schools and society. Audre Lorde (1984) argues,

> A piece of the price we paid for learning survival was our childhood. We were never allowed to be children. It is the right of children to be able to play at living for a little while, but for a Black child, every act can have deadly serious consequences, and for the Black girl child, even more so. (p. 171)

Black girls deserve to experience the joy and innocence associated with childhood. By centering Black girls' voices, Black girlhood studies seeks to dismantle systems that have historically denied access to childhood to Black girls by allowing Black girls the liberty to just be. In efforts to protect childhood for current adolescent Black girls, it becomes a responsibility of Black women to hold sacred space for adolescent Black girls and their particular liminality to be the true experts, creators, and developers of Black girlhood (Brown, 2013).

Black Girls Possess Creative Capacities

Black girlhood studies reveal the unique creative capacities Black girls hold due to their liminal positions in the world (Brown, 2013). These capacities to be imaginative and original are fostered by Black girls' experiences—who they are, where they live, what brings them joy, their cultural and generational affiliations, how they feel, what they care about, and what they hope for the future. Because they are so often pushed to the margins of the social structures they occupy, Black girls develop unique perspectives that enable them to transcend traditional ideas, rules, and patterns to produce new ideas, methods, and interpretations for navigating their worlds. Black girls' unique expressiveness, style, sound, swag, and their various forms of artistic expression (e.g., via music, spoken word, visual art, graphic art, theater, literature, etc.) are manifestations of their creativity.

Black girlhood studies suggests that Black girls' creative capacities can flourish when Black girls' interpretations of their own experiences are deemed as true, and they are recognized

as the experts on their own lived realities. Brown (2013) also argues that investment in Black girls' creative capacities minimizes the distance between Black girls' critical thoughts about the world around them, what they know to be true based on their own experiences, and their creative expressions (Brown, 2013). The creative capacities of Black girls have revolutionary power, power to change social structures and shift the political landscape.

Black Girls View the World Through a Lens of Criticality

Black girlhood studies remind us that Black girls are aware of the political landscape in which they live. They are also knowledgeable of the historical underpinnings that set the foundation for the political world they experience. Black girls are able to "see, name, and interrogate the world not only to make sense of injustice but also to work toward social transformation" (Muhammad, 2020, p. 120). Because they are already critical of the structures and systems that govern the institutions that guide them, Black girls need spaces to name and critique the injustice they experience and be encouraged to build a better future for themselves and others (Muhammad, 2020).

Black Girlhood Studies Applied

I apply Black girlhood studies in this dissertation to prioritize childhood innocence, adolescence, creativity, and the associated experiences of the Black girls who participated in Empowering Girls Through Art & Science. Using Black girlhood studies as a foundational lens, I am constantly reminded to position Black girls as children, children who are deserving of educational experiences that are age appropriate, empowering, and promote their creativity.

This positioning is not to negate the maturity and wisdom held by adolescent Black girls, but it is to disrupt the hypervisibility and harm associated with the adultification of Black girls in schools and society. In particular, the Black girls in this study, living in 2020, have had to

traverse a dramatic rupture in society caused by the global COVID-19 pandemic, the murder of Black men and women, and the era of social media, filters, online bullying, and cancel culture. Acknowledging the girls in this study as children is not choosing to ignore that they experience such realities. It is recognizing that Black girls living as children today have a completely different terrain to traverse than those of us who have come before them. I use Black girlhood studies to center their language and colloquialisms, their senses of humor, their preferred forms of expression, their aesthetic choices, their reflections of today and hopes for the future, and their overall presentations of self and their ideas. I also use Black girlhood studies' commitment to childhood to interrogate if and when Black girls signal that their childhood is being disrupted.

Although Black girlhood studies has not been used often to explore Black girls' experiences in science learning spaces, Black girlhood studies is necessary to disrupt the marginalization and invisibility of Black girls in science classrooms. I am working diligently to remain conscious of my womanhood and not assume that my experience and positionality are the same as theirs. Who I am and my experiences as a Black woman and former Black girl are important in the study and will naturally emerge, but my hope is that by guiding this work with Black girlhood studies the voices and expertise of the Black girls will be understood, elevated, and celebrated above my own. In addition to Black girlhood studies, I intertwine critical race theory as the second of three theoretical lenses I use to develop the blueprint for design and investigation in this study. In efforts to center the experiences, ways of knowing, and cultural histories of the Black girls, I used critical race theory to identify the ways that science has been exclusionary to Black girls and to offer ways forward.

Figure 3-2: ***A Gem Exists Even If You Don't Look for It.*** *This visual representation depicts what can be revealed in U.S. classrooms when the facade of objectivity and neutrality are removed from how science is presented in U.S. school. Something beautiful, something quite majestic emerges when science can also be understood from the epistemological framings and historical learning of Black communities, Indigenous communities, and other communities of color.*

The disciplines of science have traditionally been exclusionary spaces, limiting access for women, people of color, and Indigenous peoples. As described in Chapter 2, this same exclusionary ideology seeps into K-12 science classrooms and curricula, creating barriers particularly for marginalized children of color to have meaningful science learning experiences. When seeking to reimagine the experiences of Black girls in science classrooms, a critique of the disciplines of science using critical race theory is imperative. In this section, I begin by introducing critical race theory and three of its tenets—colorblind racism (Bonilla-Silva, 2015; Lopez, 2003), whiteness as property (Harris, 1993; Parker & Lynn, 2002), and counterstory (DeCuir & Dixson, 2004; Ladson-Billings, 1999; Lopez, 2003). I then use these tenets to interrogate the disciplines of science and identify critical shifts necessary to strive toward critical race-informed science education.

Critical Race Theory

Critical race theory (CRT) is an interdisciplinary theoretical framework derived from critical legal studies and radical feminism (Delgado & Stefancic, 2012). It is employed as an analytic tool to identify the ways that race, racism, and power influence U.S. society. CRT describes a theoretical reality where the experiences of Black people and people of color are validated and creates safe spaces where Black stories are elevated, and Blackness is protected (Delgado & Stefancic, 2012). CRT also exposes white supremacy in its various forms and "reveal[s] a social order that is highly stratified and segmented along racial lines" (López, 2003, p. 84). CRT asserts that the value ascribed to whiteness and the devaluation of Blackness demands a "deconstruction of … oppressive structures and discourses, reconstruction of human agency, and construction of equitable and socially just relations of power" (Ladson-Billings 1999, p. 10). CRT was first applied to the field of educational research by Dr. Gloria Ladson-

Billings and Dr. William Tate (2016) in order to underscore the fact that race remains a "powerful *social* construction and signifier" (Ladson-Billings, 1999, p.8, emphasis in original) that permeates all spaces for Black people, including education.

Critical race theory asserts that anti-Black racism is both pervasive and persistent, influencing all policies, practices, and procedures (Lawrence, 1987; Lopez, 2003; Milner, 2017; Solórzano & Yosso, 2002). Race, racism, and power are driving factors determining the quality of schooling received, types of jobs available, accessibility to homeownership, proximity to fresh produce and quality health care, and the lack of humanity afforded or denied by those sworn to protect them. With respect to schooling, Milner writes, "racism is persistent, permanent, and omnipresent in U.S. society and consequently education" (2017, p. 294). Critical race theory "challenges the traditional claims that educational institutions make toward objectivity, meritocracy, colorblindness, race neutrality, and equal opportunity" (Solórzano & Yosso, 2002, p. 26). It reveals the layers of oppression that create the structures and systems governing U.S. education and the multiple forms of resistance designed to disrupt them (Solórzano & Yosso, 2002).

Colorblind Racism

Colorblind racism describes a system of racism where racial discourse is implicit, the use of racial terminology in public spaces is avoided, and the maintenance of systems that disenfranchise people of color is upheld and yet covert (Bonilla-Silva, 2015; Chapman, 2013). This type of racism can be hard to detect because the dominant practices that produce it seem almost invisible or nonracial (Bonilla-Silva, 2015). Colorblind racism operates beyond individual choices and beliefs. It manifests in laws, policies, and organizing structures that continue to

"create and sustain barriers that limit the social and economic gains of people of color in the United States" (Chapman, 2013, p. 611).

Colorblind racism seeps into classrooms and interactions between students and school staff because of the pervasive belief that if no overtly racist acts are taking place in school (e.g., calling students racial slurs, admitting to segregating students based on race, etc.), it is a racism-free zone (Su, 2007). As a critical lens, colorblind racism illuminates how racism manifests in schools in ways that many educators fail to see or intentionally ignore. For instance, it enables the analysis that access to advanced courses, in which Black students are persistently underrepresented, relies less on test scores and more on a family's ability to pay for out-of-school tutoring. It also reveals the racism inherent in supposedly "racially neutral" discipline policies that disproportionately punish Black children and other children of color. Although educators attempt to camouflage and/or ignore the racism occurring in schools, students of color and their families are well aware of the ways it operates and the harm it does to them.

Prior to the events of 2020, many believed we were living in a post-racial era in the U.S. (Chapman, 2013). The recorded killings of unarmed Black men and women during the height of the most grueling global crisis our generation has ever experienced, COVID-19, has shifted this perspective for some. These recent events have shown many white Americans that we are not beyond anti-Black racism in our country. For others, they remain committed to operating within a paradigm governed by colorblind racism.

Whiteness as Property

Harris (1993) describes the ways that racial identity and property rights are deeply interrelated in the United States. She argues that whiteness, which was originally "constructed as a form of racial identity, [has] evolved into a form of property" (Harris, 1993, p. 1709). Dixson

and Anderson (2018) elaborate that the property functions of whiteness, including the "rights of disposition, rights to use and enjoyment, reputation and status property, and the absolute right to exclude" (p. 127). The property functions of whiteness shape U.S. society by providing a "protective veneer over White people, their self-interests, and their possessive investment in Whiteness" (Donnor, 2013, p. 201). Whiteness as property shapes schooling in part by determining whose knowledge and ways of knowing are considered legitimate in classrooms. The same hierarchical relationships of power that protect the legal interest of white European Americans (Parker & Lynn, 2002) dictate that white knowledge comprises objective truth and systemically devalue knowledge derived from communities of color by erasing it from or misrepresenting it in classroom curricula.

Counterstory

Despite the endemic nature of racism and the property functions of whiteness, celebrations of Blackness and efforts to disrupt racial inequity are ever present (Chapman, 2005). CRT argues that the U.S. societal context cannot be fully described without identifying the ways that Black people, including Black women and Black girls, reclaim and rewrite the narratives of Blackness in the U.S. These narratives are called counterstories. Counterstories elevate the voices of marginalized people and allow them to tell their own racialized and gendered stories (DeCuir & Dixson, 2004; López, 2003). Critical race theorists prioritize counterstory in research and praxis to challenge dominant narratives which are typically told from the white perspective, offering white-washed recollections of history or present-day events. Counterstory requires Black people and people of color to voice their experiences, opinions, and perspectives, and involves documenting their memories and claims without altering them. The Black Lives Matter

movement, the Black Girl Magic and Black Boy Joy movements, and the persistence of Black creatives and scholars to represent Black stories with fidelity offer beautiful counterstories.

Solórzano & Yosso (2002) offer the questions, "Whose stories are privileged in educational contexts and whose stories are distorted and silenced? … What are the experiences and responses of those whose stories are often distorted and silenced" (p. 36)? Applying whiteness as property as a theoretical lens reveals that white upper-class and middle-class stories are typically privileged in schools, while the stories of people of color are omitted and misrepresented (Solórzano & Yosso, 2002). Counterstories in education challenge deficit stories of people of color by celebrating "oral traditions, historiographies, corridos, poetry, films, [and] actos..." (Solórzano & Yosso, 2002, p. 37). Not only are these stories told from diverse perspectives, but the means of storytelling are rooted in culture and tradition established in communities of color. Exposing counterstories that chronicle the lives and experiences of people of color within the educational pipeline allows for the epistemological orientations and ontological truths of those communities to be legitimized and shared.

Critical Race Theory in Science

To interrogate the disciplines of science, I use the same CRT tenets—colorblind racism, whiteness as property, and counterstory—to reveal the ways racism is ingrained in the doing and learning of science, asserting that, from the foundations of science, its practices are incongruent with the lived realities of Black girls. My analysis of the racist and sexist nature of science surfaces five critical shifts crucial to designing spaces that can promote critical race science education. These critical shifts comprise pedagogical practices that make Black girls visible by centering their ways of knowing, being, and doing in discussions of and praxis in science learning contexts.

Colorblind Racism in Science

The exploration and teaching of science perpetuate colorblind racism in classrooms and in society because the disciplines of science claim to be objective. Science as taught in K-12 schools is rooted in white Western ideologies and is cast as an historical amalgamation of irrefutable facts and theories that claim to not be influenced in any way by human subjectivity (Harding, 2015). Scientists from this tradition claim to follow concise methods of positivist inquiry to produce neutral discoveries that are value-free, bias-free, and beneficial to all mankind. Although scholars have shown that the practices of Western science and the processes used to explore scientific phenomena have been and continue to be raced and cultured (Bang & Medin, 2010; Harding, 1995 & 2015), the fields of Western science continue to pride themselves on their "objective" exploration of the natural world (Mensah, 2018).

Numerous scholars who theorize about the epistemological and ontological foundations of science argue the opposite to be true (Bang & Medin, 2010; Harding, 1995 & 2015; Mutegi, 2011; Rodriguez, 1997; Sismondo, 2010). Harding (1995) argues that the doing of science flows from scientists' interpretations of the natural world, their interests, and their values (or the lack thereof). As a result, science is molded by the epistemological orientations of those who contribute to it, typically Eurocentric white men, including their personal blind spots and biases (Harding, 2015). The Framework for K-12 Science Education (National Research Council, 2012), which is the guiding document for U.S. science education, explicitly reifies this position, arguing that scientists' experiences and exposures influence the questions they ask, the problems they identify and choose to pursue, how they approach problem solving, and how they present their findings to others in the field. The cultural dominance of Eurocentric white men in Western science excludes and devalues the contributions of those who do not share their subjectivities.

The cultural dominance in the fields of science is blatantly evident in the current civil unrest associated with the unwanted construction of a “giant telescope on Hawai’i’s highest mountain peak” (Kelleher, 2021). The Thirty Meter Telescope would be built on Mauna O Wakea, a dormant volcano deemed sacred land by Native Hawaiians because it is “the place where the sky god, Wakea, met with Papa Hanau Moku, the Earth goddess, leading to the creation of the islands" (Murray, 2019). In opposition to the construction of the telescope, native Hawaiians and co-conspirators have been protesting for years to protect the sacredness of the land. Because the Hawaiian native people’s values, interests, and cultural epistemologies are deemed inferior to Eurocentric ways of knowing, the sacredness of Mauna Kea becomes irrelevant and scientists' desire to see 14,000 meters above sea level to explore the night sky reigns supreme (Murray, 2019). Despite the disregard, harm, and lack of cultural inclusivity, the Eurocentric axiologies supersede those of any other community, possessing the power to decide how scientific inquiry is pursued.

Applying colorblind racism as a lens helps to reveal the ways that Western science is a racialized enterprise and has occupied a substantial stake in the colonial project (Biewen, 2017). For example, Western science’s methods and discoveries have been used to justify racism, exploit people of color, and support technological advances that promote colonial authority through such allegedly “objective” projects as eugenics and the forced sterilization of Black women (Biewen, 2017). The same epistemological orientation allowed for the theft of cells from a Black woman, Henrietta Lacks, and their ongoing use to advance scientific research with no compensation to her or her loved ones (the stolen HeLa cells are still alive today, currently serving as a tool to help combat coronavirus) (Skloot, 2010). The so-called “bias-free” Western approach to science permitted the Tuskegee Syphilis Study; the atomic bombings of Hiroshima

and Nagasaki, Japan; the creation of Nazi gas chambers; the demand for building a telescope on sacred land at Maunakea, Hawaii, despite Native peoples' vehement protests; and the list goes on (e.g., Harding, 2015; Prescod-Weinstein, 2021). These horrific acts—that unfailingly target marginalized people in favor of white supremacist goals—are facilitated by the belief systems that structure the methodology and research agendas of Western science and the white supremacist values that they reify. Harding (2015) frames the problem well:

> The social justice movements have argued that there must be something wrong with even the very best scientific methodology, since it seems to have lacked the resources to block discriminatory values and interest from shaping some of what is generally regarded as the very best research.

I posit that what is inexcusable about scientific methodology is its lack of commitment to ethical obligations that protect communities most vulnerable and the foundations of science that do not deem those worthy of protection.

The harm caused to communities of color for the purpose of (in some cases) scientific discovery, but in most cases, for the lack of recognizing humanity is cloaked under the disguise that science is neutral, value-free, without bias. It is also hidden behind the facade of "the greater good" where scientific exploitation is done for the good of all mankind. Although the rules and guidelines that bound the doing of science deem the previous acts of disregard as benign pursuits of knowledge, at their core they are rooted in racist, sexist, exclusionary notions of whose lives matter and whose do not. Colorblind racism is operationalized as the fields of science develop the facade of an objective enterprise but seeping within its practices lie oppressive foundations rooted in anti-Black racism. These same covert ways are reproduced in science classrooms

through the teaching of the scientific method and through practices that prioritize white male ways of being.

Western science prides itself on its "objectivity" and "neutrality," but, despite these claims, marginalized people are continuously targeted and harmed in the name of collective advancement. This pattern of continuous harm to communities of color undermines Western science's claim of "objectivity." If the pattern of harm continuously leads the fields of science to disregard the wants, needs, and well-being of communities of color, how objective can the fields be? Since the claim of "objectivity" is foundational to Western scientific epistemology, yet history illustrates all the ways that science is steeped in subjective bias, all that is birthed from the foundations of science must be scrutinized and reconstructed. The same critical scrutiny and revision of science must also occur in K-12 science classrooms that currently seek to mimic the professional fields of science for children. Using the framework of colorblind racism as a critical lens facilitates the interrogation of the disciplines of science. The interrogation of colorblind racism in science results in unearthing the ways that the foundations of science are exclusionary and discriminatory. It also reveals the ways these ideals are replicated in the teaching and learning of science.

Whiteness as Property in Science

Science operates as a property function of whiteness (Mensah, 2018; Shizha, 2007). In other words, what is validated as scientific knowledge and who is deemed scientifically inclined are determined in the dominant system using the norms set by those who ascribe to whiteness. Applying whiteness as property as a lens reveals the ways that Western science is operationalized to answer white questions, to promote white ideas, and to position white methodology as the only legitimate approach to scientific inquiry (Mensah, 2018). As a property

function of whiteness, Western science limits the search for legitimate scientific truth to include only the epistemological orientations of whiteness. Because of this, people of color are not seen as valuable contributors of scientific knowledge. Mensah writes:

> …the right to use and enjoyment of science—what science looks like, who engages in science, and what science is for—historically has meant a disregarded and exclusionary view of science where women and people of color with their indigenous knowledge, and cultural frames of reference do not have a right to use science or enjoy it. (2018, p. 9)

Other ways of knowing and doing science derived from non-Eurocentric white cultures are viewed through a deficit lens or are not considered scientific at all (Bang, Warren, Rosebery, & Medin, 2012; Mensah, 2018). Not only are non-Eurocentric white epistemological orientations considered tangential--at best--to dominant ways of knowing and doing science (Bang, Warren, Rosebery, & Medin, 2012), but non-white peoples' existence as science doers is also stifled. Dominant Western science, as is, thus operates as a gatekeeper, preventing those who do not ascribe to whiteness from entering the fields. Additionally, those who do not ascribe to white masculinity are also excluded. White men dominate the histories of science and dictate the ways of being and doing considered acceptable in the fields (Sismondo, 2010).

Framing science as objective is a method to protect white ownership of scientific knowledge (Harding, 1995; Mensah, 2018). The litmus test to determine whether something upholds the values of scientific inquiry has been its approximation to this kind of objectivity—objectivity upheld by adhering to the rigidity of the scientific method and peer review guidelines. As explored in the previous section, using objectivity as the mandatory requirement for scientific acceptance inherently excludes those who are not white and elevates the contributions of those

that are because the requirement to pursue objectivity reflects and upholds white ways of knowing, being, and doing.

The prioritization of whiteness in scientific discourse makes it extremely difficult for women and women of color to be respected contributors (Harding, 2015; Sismondo, 2010). As such, science as the property function of whiteness shapes science classrooms and Black girls' experiences in them. Although "Black girls hold a unique capacity to be productive members of the scientific community" (Young, Feille, & Young, 2017, p. 3), their intersectional expressions (i.e., ways of communicating, their visual appearance, their cultural backgrounds, languages, etc.) that are steeped in Black girlhood prove to be incongruent with the requirements of objectivity. Their creative expressions and critical lenses on the world do not align with science teaching and learning driven by knowledge and methods of expression that are inherently white.

Counterstory in Science

The CRT tenets of colorblind racism and whiteness as property help to illuminate the ways that dominant science has been exclusive and harmful to communities of color. Using counterstory as a lens to interrogate the disciplines of science foregrounds the epistemological and ontological orientations of communities of color. Normative Western approaches to science create a distinction between nature and culture, but scholars who center Indigenous ways of knowing and being articulate the ways that Indigenous communities experience nature and culture as dependent on one another (Bang, Warren, Rosebery, & Medin, 2012). Elevating counterstories in science yields new ways to conceptualize the relationship between humanity, spirituality, cultural experiences, and nature (Bang & Medin, 2010).

Counterstories emerge when diversity is truly valued within science. By diversity I am referring to more than an increase in physical representation of non-white people. Diversity is

also the incorporation of a variety of values and ideas such as those of women and people who identify as Black, Indigenous, and People of Color (Harding, 2015). Harding (2015) argues that when true diversity is accomplished, the counterstories that these groups bring with them enable true objectivity to be achieved. She calls this "strong objectivity" (p. 569), claiming that to maximize scientific objectivity individuals from a variety of racial, cultural, gendered, socio-economic, and intellectual groups must be present in spaces where research criteria are developed. Cultivating such diversity allows for the detection of unethical behavior that can cause harm to our nation's (and our world's) most vulnerable groups. However, there is no single, monolithic counterstory that captures the personal and lived experiences of all people (Delgado, 1990). As such, it is imperative to continually employ counterstories to inquire about various communities' ways of knowing and scientific understandings.

Wrestling with counterstories of science can and should inform science education. In addition to the importance of incorporating young people's diverse ways of knowing and being into instruction, youth are capable of navigating across multiple epistemologies of science (Bang & Medin, 2010). They can think in complicated ways to explore various forms of knowledges and decide how those knowledges relate to their lived realities, which enriches their learning in ways that a narrow adherence to dominant Western epistemologies cannot. Elevating counterstories in U.S. science classrooms opens the gate to make science more accessible and meaningful to children of color.

Critical Shifts for A Critical Race-informed Science Education

The critical explorations of science detailed above illustrate the need for a critical race-informed science education. Developing a complete theory and praxis of critical race-informed science education is beyond the scope of this study. However, based on the critiques of science

offered above, I argue for five critical shifts necessary for revolutionizing science education. The critical shifts described are not minor reforms to science education. They are major shifts to the very foundation of science education. These critical shifts are aspects of science education that must be made explicit and visible because they can easily slip into patterns of colorblindness, exclusion, anti-Blackness, and intersectional oppression. Non-systematic efforts can easily recreate marginalization of Black girls by insubvertively valuing tracking and meritocracy, for example. The critical shifts that scholars, teachers, and administrators in science education must consistently wrestle with are:

1. Revolutionizing curricula, standards, policies, and conversations around science to explicitly address issues of race, whiteness, white supremacy, anti-Blackness, and intersectional exclusion within science learning spaces.
2. Prioritizing histories of science that center the contributions of people of color (with particular attention to Black women) and the ways science has harmed, erased, or taken advantage of them.
3. Reckoning with Western science's and scientists' disregard for ethical obligations, which has systematically marginalized particular individuals and communities.
4. Developing new, culturally relevant learning contexts that allow space for students to navigate across diverse epistemologies of science and to learn about science exploration in other cultures outside of modern Western science.
5. Dismantle structures and barriers that push Black, Indigenous, and other students of color to the periphery of science learning spaces.

Undertaking the five critical shifts described above requires investment from all stakeholders who have power to make decisions. It also demands substantive and systematic

efforts to diversify who has a seat at the table to determine the vision for science education in the U.S., craft national standards, and design curriculum and assessments. Developing standards and curricula will have to move beyond what *A Framework for K-12 Science Education* (2012) calls the three dimensions of learning (i.e., science and engineering practices, crosscutting concepts, and disciplinary core ideas) to include various ways of knowing, being, and doing as foundational. It will require a great deal of unlearning and relearning for all stakeholders. Those in leadership roles (teachers, school and district administrators, curriculum designers, etc.) must be supported to shift their ideologies away from the current narrative of science as benign, objective, and without blemish, to thinking critically about the fields of science. This work also requires the recruitment of and investment in science teachers of color to teach in schools, especially schools with high populations of children of color. Financial resources must also be allocated to develop a science education that values critical race-informed learning environments for all students.

In the remainder of this chapter, I turn to operationalize the five critical shifts in this study to create a science learning environment where Black girls can think critically about science and feel represented in the content explored. I discuss the curriculum for Empowering Girls Through Art & Science in more detail in Chapter 4: Methods.

Figure 3-3: ***An Unchained Mind.*** *This visual representation depicts the liberatory power of the Black imagination. As much as society and the systems that govern it attempt to constrain the Black mind, the Black body, the Black future, Black people exist, create, and dream beyond those limitations. Our imagination has historically led to movements for freedom and justice.*

Critical race theory foregrounds analysis of the status quo in science and science education—what is and what has been. Afrofuturism offers a conceptual framework that pushes us to consider what could be instead. In other words, Afrofuturism foregrounds the role of imagination in disrupting intersectional oppression. In this dissertation, I use Afrofuturism to focus on the ways adolescent Black girls express their Black girl imaginations in an informal science learning space that prioritizes the exploration of critical histories of science.

Few scholars have studied the experiences of Black girls in informal science learning spaces and even fewer have sought to understand the ways in which Black girls' criticality, creativity, and imaginations emerge in the exploration of scientific histories. However, in the fields of science fiction, speculative fiction, and fantasy, Black women Afrofuturists have been theorizing about the ways Black girls reconcile with the past, use a critical lens to make sense of the present, and imagine futures that exceed the possibilities of their lived experiences (Morris, 2012; Womack, 2013). These Black women contribute to the field of afrofuturism as writers, comic book creators, movie producers, musicians, clothing designers, and Black radical theorists. Through their artistic creations they choose to defy reality by imagining worlds where Black people resist, create, triumph, and walk boldly in their agency. I argue that the field of science education has much to learn from these Afrofuturists.

In this section, I articulate how the work of Black women Afrofuturists and the field of afrofuturism can be used to expand what is considered "scientific," redefining when, where, how, and by whom science takes place. I also explore how afrofuturism elevates Black girls and women, leverages the interconnectedness of the past, present, and future, and highlights the liberatory power of the Black imagination. I then build from the theoretical and artistic space created within the realm of afrofuturism to conceptualize *Black girl imagination*.

Defining Afrofuturism

Afrofuturism is a philosophy of science and a philosophy of history that visually represents the intersections of imagination, Black liberation, technology, and the future (Womack, 2013). Afrofuturism is "both an artistic aesthetic and a framework for critical theory" (Womack, 2013, p. 9) that blends elements of science fiction, historical fiction, speculative fiction, fantasy, and Afrocentricity. It is a multi-generational form of expression that utilizes visual language to produce various forms of Afrocentric imagery. The imagery produced transcends social limitations to celebrate the legacy and strength of Black people. Whether through literature, music, visual art, or community organizing, what remains essential to afrofuturism is the use of the Black imagination to re-envision the past or create futures where Black people are centered and thriving.

The term "afrofuturism" was formally introduced in 1994 by Mark Dery in his efforts to "describe African American culture's appropriation of technology and science fiction imagery" (p. 8). However, the afrofuturistic aesthetic dates to the 1950s, as Black musicians like Sun Ra; Jimmie Hendrix; Earth, Wind, and Fire; and Parliament Funkadelic used vibrant, space-themed fashion, song titles, and album covers (Womack, 2013). These creators artistically positioned themselves and other "Black people in situations nobody ever thought they would be in" (Bird, 2013, p. 4). George Clinton, lead member of the Parliament Funkadelic, says, "… like the white house... I figured another place you wouldn't think Black people would be was in outer space" (Bird, 2013, p. 4). These afrofuturists were resisting the stereotypical positioning of Black people. Even in the early expressions of afrofuturism, forms of expression went beyond the merely aesthetic to reveal a social commentary, mixing science fiction themes and Black culture.

From the beginning, afrofuturists were in pursuit of creating futures where being Black was limitless and not burdensome.

Locating Black Girls (and Women) in Afrofuturism

Afrofuturism promotes the visibility of strong, worthy, and diverse representations of Black people generally, and Black girls and women in particular. By nature, Afrofuturism disrupts dominant narratives and repositions Black people at the center of their own stories. It is about freeing the Black identity from the burden of awful stereotypes that position Black people as violent, uneducated, or lacking nuance (Womack, 2013). Afrofuturism especially operates as a "free space for women, a door ajar, arms open wide, a literal and physical space for Black [girls and] women to be themselves," (Womack, 2013, p. 100). Within afrofuturism, Black girls and women exceed the narrow stereotypes--of Black women as angry, Black girls as hypersexualized--that white supremacy imposes upon them. They are able to exist as heroes (i.e., Thunder & Lightning from CW's *Black Lightning* superhero television drama series), as protagonists (i.e., Dana from Octavia Butler's grim fantasy novel, *Kindred*), as genius (i.e., Riri Williams from Marvel Comics' *Ironheart*), and androgynous (i.e., Janelle Monáe and Grace Jones in their musical representations of themselves). Within the Afrofuturist paradigm, Black girls and women can be whoever or whatever they want to be.

Expanding What is Considered Scientific

As outlined above, the way science is typically presented in society and taught in K-12 classrooms perpetuates exclusion. Using critical race theory to redefine science education exposes the ways that science is operationalized to maintain white superiority and the exclusion of any non-white ways of knowing and being. Critical race theory offers an analytic frame to peel back the layers of science that are often left unearthed to locate how the core of Western

scientific exploration and mainstream science learning are innately anti-Black. Afrofuturism offers a path forward from this analysis. Womack asks the question, "Can Afrofuturism, through literature, music, or theory, be a way to change prevailing ideas about what science and tech looks like" (2013, p. 46)? In this dissertation, I answer yes. Afrofuturism offers new ways to define the doing and learning of science, ways that center people of the African diaspora and their stories.

Within afrofuturism, the "doing of science" extends beyond laboratories and spaces where old white men wearing pristine white lab coats work at lab benches and under fume hoods. Doers of science are now wearing masks and latex and/or are adorned with African beaded jewelry, African fabrics, and tribal body paint. Doers of science are now Black people, Black women, Black girls who travel throughout space and time using their intellectual acumen to defy stereotypical norms of who they are expected to be. Science is done in secret safehouses, in high tech dungeons, on other planets, in Black neighborhoods, and in African countries.

For example, in the film *Black Panther* (2018), Shuri is an adolescent Black girl, the princess of Wakanda, and the scientific genius behind Wakanda's technological advancements can be seen disrupting what has typically been viewed as scientific inquiry. With her melenated skin, box braids, and humor, Shuri uses natural resources (vibranium) to create the sophisticated technology needed to save the world. Shuri, along with many other Black girls in the realm of afrofuturism, redefine the context of doing science in ways that celebrate the diversity and brilliance of Black people.

I utilize afrofuturism in this study to shift the critical conceptualization of science from what it is *not* (articulated using CRT) to imagine what science *could* be when counterimages that reject what textbooks typically depict as science doing and science doers are foregrounded.

Using afrofuturism as a theoretical lens also disrupts normative ideas of science by positioning the doing of science in conversation with artistic expression. Afrofuturism exists across genres such as cinema, music videos, album cover art, comic book strips, fictional writing, and song lyrics. Within afrofuturism, the relationship between creativity and scientific inquiry are cyclical. Afrofuturists use science fiction and artistic expression to illustrate Black people engaging in redefined visions of science which expose the fields of science to ideas that are impossible under the constraints of the status quo. These impossible feats can become visions of what is possible and drive scientific exploration. In response, afrofuturists continue to use their imaginations to push what is possible forward, centering Black stories.

The Interconnectedness of Past, Present, and Future

Afrofuturists use creative expression to reimagine the past, present, and possible futures through a Black cultural lens. Dominant, Eurocentrically driven expressions of science fiction traditionally depict time as linear, but in afrofuturism, the past, present, and future are always existing at the same time and it is hard to distinguish among them because they are deeply reliant on one another (Womack, 2013). The interwovenness of the past, present, and future demands that creating futuristic paradigms require a historical reimagination, as well.

The interdependence of the past on the present and the future inspires the way I explore scientific histories in this study. The scientific histories explored in the Empowering Girls Through Art & Science curriculum offers opportunities for students to reflect on the past, while imaging new futures. Afrofuturism provides a lens with which to change the way we see the future. Specifically, it enables us to imagine a future where Black people are not only included but are in control of their own destinies. It allows us to explore the current problems faced by the

Black community, simultaneously relying on the past for wisdom and creating futures where Black people thrive for their own sake (Morris, 2019; Womack, 2013).

Liberatory Power of the Imagination

Afrofuturism is the manifestation of a liberated Black imagination. According to Merriam-Webster (2020), imagination is "the act or power of forming a mental image of something not present to the senses or never before wholly perceived in reality." The Black imagination is the act of creating new worlds and experiences from the Black liminal perspective (Kelley, 2002). Within the Black imagination Black people can be free from the limitations of identity and the societal constraints associated with being Black (Womack, 2013). Afrofuturism "unchains the mind" (Womack, 2013, p. 14), allowing the imagination to flourish. It provides a moment of respite for the Black mind because the Black imagination does not require the maintenance of institutional and systemic structures. Afrofuturists use their artistic expression to dream despite those structures and imagine liberatory spaces that dismantle them.

The tradition of science fiction or futuristic works can be traced back to people of African descent in precolonial Africa, indicating that the current use of fantasy and fiction to disrupt daunting power structures is a legacy of a lineage of resistance (Womack, 2013). Womack (2013) argues that Afrofuturists are aware of the social constructs that have been violent toward Black lives, Black culture, and Black histories, but imagining provides them a space for free mental play, where they can dream outside of what is considered reality: "An afrofuturist is not ignorant of history, but they do not let history restrain their creative impulses either" (p. 16). Instead, Afrofuturists use their creative prowess to push back on systems designed to destroy or misrepresent Black people.

I use afrofuturism as a foundational lens in this study to recognize the Black imagination as a space of rest and repair. I also prioritize the Black imagination as a form of resistance that is integral to the fight for social and racial justice.

Black Girl Imagination

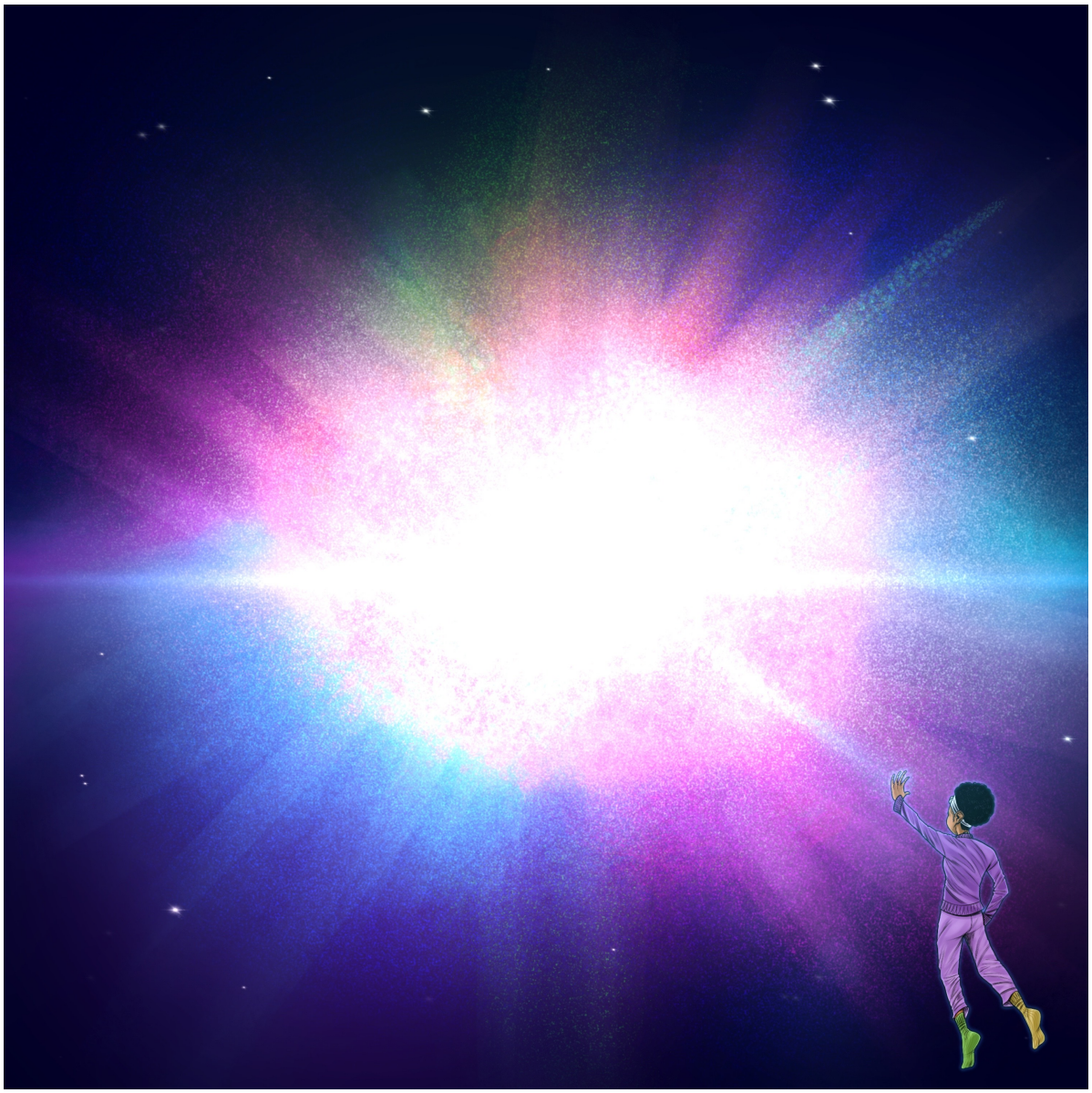


Figure 3-4: ***May The Force Be You.*** *This visual representation depicts the power associated with a particular imagination Black girls possess. The Black girl imagination exists because of Black girls' experiences as children, critical citizens of the world, and creative beings. Power to produce change, cultivate joy, and redefine Black girlhood is all a product of the force of Black girls' imaginations.*

Black girls are descendants of a people who, across history, have been habitual dreamers as a means of survival. Black people have been imagining new possibilities that defy their lived realities for centuries (Kelley, 2002). In addition to scholars in the genre of afrofuturism, Robin D.G. Kelley (2002) theorizes about the Black imagination more broadly. He incorporates conceptions of the Black radical imagination into Black cultural studies to articulate the liberatory power found in the imaginations of Black people. Kelley defines imagination as the ability to dream of new worlds that are radically different from the one inherited by the dreamer. He argues that imagination is integral for change--any movement toward freedom must originate in the mind; it must begin in the imagination.

The imagination has historical significance for Black people's pursuit of freedom. It is passed down from generation to generation, infused in the lives of Black children, with the goal being to "resolve the contradictions between everyday life and our wildest dreams" (Kelley, 2002, p. 5). Historically, radical social movements have been inspired by hope and dreams for better futures in the face of present lack, misery, and oppression. For generations, Black leaders, visionaries, and activists have cultivated their dreams for a radically different future, which have formed the basis for movements like the abolition of slavery, the Great Migration, the Black feminist movement, and now the Black Lives Matter Movement. These historical and contemporaneous movements only emerge because someone dares to dream and act on that dream. Imagination is the essential ingredient.

In this dissertation, I argue that Black girls, operating from their own liminal perspectives and distinct identities, have a unique imagination: their *Black girl imagination*. *Black girl imagination* is the dialogical relationship between Black girls' childhood abilities to be creative and to imagine and their abilities to be critical of the structures that shape the world around them.

Similar to the Black radical imagination Kelley (2002) describes, Black girls imagine futures for themselves and those around them that push beyond systemic structures designed to marginalize them. These desired futures are birthed from their own unique experiences at the intersections of race and gender. I further argue that Black girl imagination is always present. It motivates Black girls' resilience as they seek visibility for themselves in spaces that overwhelmingly position them as invisible and hypervisible. Typically, schools work to stifle and constrain Black girl imagination. Moreover, the curriculum, teachers, and school staff lack the imagination necessary to visualize Black girls in their full capacity (see Chapter 2). Black girl imagination plays a crucial role in enabling Black girls to navigate these realities.

Others have implicitly addressed the importance of Black girl imagination in fiction and non-fiction text that center Black girls. In her memoir entitled, *Shapeshifters: Black Girls and the Choreography of Citizenship*, Aimee Cox (2015) explores how Black girls and young Black women in a Detroit homeless shelter push back against stereotypes, fight to be recognized as full citizens, and traverse poverty, racism, and gender violence to imagine beautiful lives for themselves. Cox illuminates Black girl imagination by centering the voices of Black girls and women who use creativity to solve problems, in ways that are exclusive to those who are young, Black, and female in America. Similarly, Octavia Butler is a prolific science fiction author who wrote a suite of novels that center the stories of Black girls and women. Her stories capture Black girls' abilities to imagine themselves in the future to create worlds that seem impossible under present circumstances. In her book *Kindred*, Butler (1979) writes of Dana, who finds herself being forced to travel back and forth in time from her current reality in 1976 to a life of slavery in the antebellum south. While in the past, Dana uses her imagination to help create a future better than the one she left. Butler uses time travel and juxtaposition of life before and

after slavery to show how what Dana thinks in her mind--what possibilities she imagines--decides what the future becomes.

I build on Kelley's (2002) work and the work of authors like Aimee Cox and Octavia Butler to conceptualize Black girl imagination. More specifically, the theoretical lens developed from the intersections of Black girlhood studies, critical race-informed science education, and afrofuturism expand Kelley's articulation of the Black radical imagination by acknowledging that Black girl imagination emerges when Black girls are able to be children uninterruptedly, when their critical views of the world are honored and welcomed, and when they are given space to express themselves creatively. I argue that investing in Black girl imagination means to invest in three key components of Black girls' lived realities: (1) recognizing and protecting Black girl *childhoodness*; (2) legitimizing Black girls' *criticality*; and (3) elevating Black girls' *creativity*. I use the key features of the conceptual framework visually represented in table 5-1 to further define Black girl imagination.

Black Girl Childhoodness

I define Black girl childhoodness as the amalgamation of experiences that Black girls have as they occupy the unique intersections of their identities. Black girl childhoodness includes joy, play, innocence, and the ability to take risks and learn. This joy and innocence derive from the identities outlined by Black girlhood studies, which are race, gender, class, and age identities coupled with Black girls' generational affiliations, proximity to technological advances (and social media), geopolitical locations, and locations in the world (Smith, 2020). Black girl childhoodness is greatly influenced by the time and place in which Black girls are children. For example, the Black girl childhoodness I experienced as an adolescent Black girl in the 1990s significantly differs from the Black girl childhoodness experienced by adolescent Black girls

during 2020. This difference results, in part, from differences in the sociopolitical context. For example, factors like who is president, domestic and international political relations, the state of race injustices and the demands for equity, or the presence or absence of natural disasters or global pandemics shape how Black girls experience childhoodness differently from one era to the next.

Black Girl Criticality

Criticality is defined as "the capacity to read, write, and think in ways of understanding power, privilege, social justice, and oppression, particularly for populations who have been historically marginalized in the world" (Muhammad, 2020). When youth view the world with a critical lens, they are able to recognize and scrutinize the world to make sense of inequality as well as to seek change for the future. As Black girls occupy distinct locations based on the intersections of their particular identities at specific points in time, a unique criticality emerges. The liminal perspectives that Black girls possess necessitate Black girl criticality.

Black girl criticality is steeped in childhoodness, in both their physical and structural locations, in what they are able to see, in what they have access to, in what they do not have access to, and in how they express themselves. As argued in Chapter 2, Black girls advocate for themselves and others because they are knowledgeable of the structures in place to disenfranchise them and those in their communities. Black girl criticality signals that Black girls are watching, they are listening, they are experiencing the world around them, and they have opinions about it all. They are not aloof from the goings on in the world. They have legitimate critical lenses and experiences and have ideas to inspire ways forward for a better future.

Black Girl Creativity

Black girls' childhoodness and critical lenses inspire specific expressions of creativity. This is because Black girls' survival has long necessitated the ability to envision and see beyond one's immediate lived reality. Black girl creativity not only includes the ability to create visual art, but also encompasses literary art, performance art, language development (slang), fashion, hairstyling, make up, ways of being, etc. However, it is important to note that Black girl creativity exists even if no "art" is produced, if no music is played, if no song is written. Black girl creativity goes beyond artistic expression. It elevates Black girls' ability to create something unique out of nothing or repurpose something old and make it new. When Black girls are given space to create and produce, their Black girl imaginations may thrive and develop new possibilities.

Further, Black girl creativity holds great power as it has the ability to shift the culture. As Black girls express their creativity, fueled by their experiences as children and by their critical views of the world, they have the ability to define innovation for a generation. Social media currently serves as a popular venue where Black girl creativity flourishes. For instance, Tik Tok is a social media platform that allows users to share short videos, most of which are short video clips of teens doing dances to popular hip-hop songs. Of the most viral Tik Tok users, Black girls like Jalaiah Harmon have gone down in social media history as the originator of one of the most viral dances in 2020. Jalaiah's "Renegade" dance to K Camp's "Lottery" inspired Tik Tok users young and old across the world. Black girl creativity is authentic. It is powerful. It is culture shifting. It is excellent!

Nurturing Black Girl Imagination

Black girl imagination is able to fully emerge when Black girls are (1) afforded the right to enjoy their childhoods uninterrupted, (2) offered opportunities to express their critical

perspectives about oppressive structures and institutions even if they do not articulate them in ways that a scholar would, and (3) are celebrated for creating something new as a result of (1) and (2). I argue that Black girl imagination is always present wherever Black girls are, but there are certain environments that can stifle it. If one of the key components of Black girl imagination (childhoodness, criticality, or creativity) is denied, Black girl imagination is stunted. If Black girls' childhoodness is denied, Black girl imagination is stunted. If environments do not offer critical perspectives on the topics discussed or do not inquire about girls' intersectional experiences, Black girl imagination is stunted. When opportunities are denied for Black girls to talk, to express themselves, to dress how they want to dress, to say what they want to say, to disagree how they want to disagree, Black girl imagination is stunted. There is power in nurturing Black girl imagination. It disrupts all acts of hypervisibility and invisibility that Black girls experience and pursues the positivity visibility of Black girls at all costs. Nurturing Black girl imagination recognizes that protecting the visibility of Black girls has the potential to elevate elements of Black girlhood we have yet to uncover.

Using Black girlhood studies, critical race theory in science education, and afrofuturism illuminate key features of Black girlhood that deserve to be centered as we seek to learn more about Black girls in science learning spaces. I designed my conceptual framework to reveal the liminal positions that Black girls occupy, the ways science education can prioritize those positions, and how we can reimagine science as a space for Black girls. This study offers one example of what happens when typical science education is disrupted and nurturing Black girl imagination becomes a programmatic and pedagogical priority. Using portraiture as methodology, I present visual and narrative portraits of three Black girls that elevate their Black

girl imaginations and how the conceptual framework presented here aided in exploring the presence of childhoodness, criticality, and creativity.

Chapter 4
Research Methods, Design, and Presentation

Figure 4-1

Beyond These Four Walls. *This visual representation depicts the peculiar context surrounding the girls in this study. The girls joined Empowering Girls Through Art & Science virtually from bedrooms, dining rooms, and basements, while the external context overwhelmed by COVID-19*

and the racial unrest in our country invaded their daily existence and influenced their program participation.

This dissertation study examines the ways Black girls express their *Black girl imagination* in a critical, informal science learning program held virtually during the context of the summer of 2020. The goal of the study is to identify the ways Black girls actualize their *Black girl imaginations* through expressions of childhood, creativity, and criticality. In offering a new conceptual frame, *Black girl imagination*, I turn the field's attention to focus on what can be learned from three Black girls when they are able to exist in a learning program characterized by curriculum, expectations, and routines designed to nurture their visibility. As outlined in Chapter 1, I aim to answer the following research questions:

1. How do adolescent Black girls express their *Black girl imaginations* when participating in a critical, informal science learning space designed with them in mind?
2. What do their expressions of *Black girl imagination* reveal about their articulations of self?
3. What do their expressions of *Black girl imagination* reveal about their meaning making in science?

In this chapter, I discuss the study methods and design. I begin by presenting portraiture, the guiding methodology that frames data collection, analysis, and presentation. I then describe and discuss: (1) the research context, including the ways that COVID-19 and the 2020 racial unrest influenced the research setting; (2) the methods of data collection; (3) my positionality as researcher, program facilitator, and portraitist; and (4) the methods of data analysis and synthesis.

Portraiture as Method of Analysis and Data Presentation

In Chapter 2, I argue that Black girls are tasked with navigating the omnivisibility of Black girlhood—being simultaneously invisible, hypervisible, and visible—in U.S. schools and particularly in secondary science learning environments. I also argue that there is a lack of science learning programs that promote the visibility of Black girls, which prevents the field of science education from truly knowing who Black girls are and how they engage with science. In Chapter 3, I argue that to develop such programs, learning environments and curricula must be designed to nurture Black girl imagination by centering Black girls' experiences and protecting their childhood, creativity, and criticality. In this chapter, I will discuss how I employ portraiture (Lawrence-Lightfoot and Davis, 1997) as a qualitative method to ensure Black girls and their imaginations are centered in this study.

Portraiture is traditionally conceived as a genre of artistic expression in which an artist uses paint, photography, or sculpture to represent the likeness of a person, paying particular attention to physical attributes and characteristics that make the person unique. Famous portraitists, including Frida Kahlo, Jean-Michel Basquiat, Vincent van Gogh, and Pablo Picasso, are known for their ability to capture the full essence of an individual in a single image. In education research, portraiture, as introduced by Dr. Sara Lawrence-Lightfoot (1997), remains true to the essence of the artistic genre, but uses narrative writing (instead of visual artistic expression) to capture the complexity, dynamics, and subtlety of the human experience.

Portraiture is a qualitative research methodology that seeks to capture and interpret the perspectives and experiences of people and their lived realities (Lawrence-Lightfoot, 1997). Within this paradigm, the researcher (or portraitist) does not take an expert, distant perspective when seeking to learn from study participants. On the contrary, portraitists aim to gain a deep understanding of how people are experiencing their worlds and how they are responding to the

broader cultural realities around them by having up close, in-the-moment interactions with them (Lawrence-Lightfoot, 2005). Portraiture is an empirically rich social science method that allows the reader to develop a more nuanced understanding of participants in a research study. Portraiture allows the researcher to include aspects of a participant that are often omitted from more typical forms of research, such as "attitudes, feelings, colors, pace, and ambiance" (Lawrence-Lightfoot, 1997, p. 28). Findings are presented as interpretive narratives of participants in a study or a study's setting; they can be accompanied with visual, poetic, or spoken word representations as well.

Lawrence-Lightfoot and Davis (1997) describe engaging in the process of portraiture (collecting and analyzing data) and rendering the product (the portrait) as an act of boundary crossing. I propose that there are two ways that the method traverses boundaries. First, in educational research, portraiture is a method of social science inquiry that allows for a crossing between aesthetics and empiricism, emotion and intellect (Lawrence-Lightfoot and Davis, 1997). Portraiture reveals that art and science can exist more fully when they are employed together, despite dominant, Western epistemology's insistence that they are distinct. Second, portraiture bridges the gap between the academy and mainstream society, creating a product that can "capture the attention of a broad and eclectic audience" (Lawrence-Lightfoot and Davis, 1997, p. XVI). Portraiture's presentation of findings in intentionally accessible ways enables those outside of academia to traverse the boundaries that traditionally exclude them. It also requires that those who conduct research escape the universities and institutions (along with the dominant Western norms that guide them) to explore life among people, in community. Portraiture acts as a bridge between those who exist in the academy and those who do not, elevating the lived experiences of those often denied entry into the intellectual doings in the ivory towers.

Portraiture is particularly useful and appropriate for this study as I seek to foreground nuanced presentations of the girls in the study and their creative capacities. I am committed to presenting the findings in ways that are empirically sound but are also accessible to the girls, their families, and others outside of academia. My strengths as an educator and researcher are also enhanced using portraiture as methodology. It provides me with a sense of liberation where I feel free to express myself creatively and artistically in a space, I often feel restrained from doing so. Portraiture recognizes the vitality of the portraitist's authentic presence in the construction of the portraits, so my personal liberation and creative expression have become necessary inclusions as I seek to employ portraiture with fidelity. To further articulate how I use this methodology to guide this study, I discuss how portraiture is driven by what Lawrence-Lightfoot and Davis (1997) describe as the pursuit of "goodness" and its five essential features.

The Pursuit of "Goodness"

Portraiture focuses the research process on the pursuit of "goodness," a pursuit of what is worthy and what is working (Lawrence-Lightfoot and Davis, 1997). It offers a self-conscious alternative to traditional social science research that is consumed with pathology, seeking to solely uncover what is wrong, what is broken. By intentionally pursuing what is good, the portraitist hopes to transfer the goodness identified in one setting to other settings in efforts to improve them (Lawrence-Lightfoot, 2016). This pursuit of goodness should not be misunderstood as an attempt to romanticize reality. Lawrence-Lightfoot and Davis (1997) clarify by writing:

> By goodness … we do not mean an idealized portrayal of human experience or organizational culture, nor do we suggest that the portraitist focus only on good things, look only on the bright side, or give a positive spin to every experience. Rather we mean

> an approach to inquiry that resists the more typical social science preoccupation with documenting pathology and suggesting remedies ... Rather than focusing on the identification of weakness, we begin by asking, what is happening here, what is working, and why? But in focusing on what works, on underscoring what is healthy and strong, we inevitably see the dark shadows of compromise, inhibition, and imperfection that distort the success and weaken the achievements. (pp. 141-142)

Portraiture is necessary for this study as an antidote to the hypervisibility and invisibility Black girls typically endure in science education spaces (see Chapter 2). Portraiture makes it possible to present counterstories of Black girls in science by intentionally speaking to what is "good" about them in these spaces. By employing portraiture in this study, I seek to push back on presentations of Black girls in literature and media by making their "goodness" visible to science educators. Portraiture allows me to present Black girls as whole, powerful, and diverse.

Five Essential Features

Portraiture is defined by five essential features: context, voice, relationship, emergent themes, and aesthetic whole (Lawrence-Lightfoot and Davis, 1997). These features informed data collection and analysis, including the development of my coding scheme. Foregrounding these five features allows me to "organize [a collection of three] narrative[s] around central themes from the data and write layered stories where participants are subjects, not objects, in the research" (Hill-Brisbane and Given, 2008, p. 645). I explain the five features here and discuss how they are applied in this study.

Context

In portraiture, the context is defined as the setting--whether physical, geographical, temporal, historical, cultural, or aesthetic--which provides "rich resource[s] for examining and

interpreting behavior, thought and feeling" (Lawrence-Lightfoot and Davis, 1997, 41). Context is critical in portraiture because it is used to create a picture for the reader to see, feel, and experience the study participants' surroundings as much as possible. A narrative description of the context is written into the final portrait(s) and clearly connects to participants' behaviors throughout the study. The context in this study was cultivated by me (as instructor) and the girls in a virtual setting using a video conferencing platform. I paid particular attention to the profound ways it was shaped by the COVID-19 pandemic and the racial unrest experienced during the summer of 2020. Later in this chapter, I unpack how the context shaped the participants and consequently the research context as a whole.

Voice

Portraiture acknowledges the significance and omnipresence of the portraitist's voice in all aspects of research. At the same time, the portraitist must be disciplined and restrained with the presence of her voice so as not to overshadow the voices of research participants (Lawrence-Lightfoot and Davis, 1997). The portraitist's voice is "everywhere: in the assumptions, preoccupations, and framework she brings to the inquiry; in the questions she asks; in the data she gathers; in the choice of stories, she tells; in the language, cadence, and rhythm of her narrative" (Lawrence-Lightfoot and Davis, 1997, p. 85). In creating the portrait, the portraitist's voice emerges as witness (engaging as a discerning observer, sufficiently distanced from the action to identify overarching patterns), as interpretative (seeking both vivid detail and low inference descriptions), as preoccupation (guided by assumptions, disciplinary background, and theoretical perspectives), as autobiographical (informed by familial, cultural, and ideological histories), as discerning others (listening for the voice of participants in what is said, gestured,

and in the silence), and as a voice in dialogue with participants (the portraitist's voice in concert with participants') (Hill-Brisbane and Given, 2008; Lawrence-Lightfoot and Davis, 1997).

In this study, my voice is ever present. I straddle my experiences as an adolescent Black girl in science learning spaces and my experiences creating empowering science learning spaces as a Black woman as I engage with participants throughout the study and listen to their stories. Attending to voice enables what Lawrence-Lightfoot and Davis call the "singing [of] a duet" (1997, p. 103)—the process of balancing my interpretive voice as the portraitist with those of my participants, ensuring my voice does not eclipse, but rather elevates theirs.

Relationship

The relationships between the portraitist and participants are the foundation of portraiture (Lawrence-Lightfoot, 2016). It is through the nurturing of relationships "that access is sought and given, connections are made, contracts of reciprocity and responsibility (both formal and informal) developed, trust built, intimacy negotiated, data collected, and knowledge constructed" (Lawrence-Lightfoot and Davis, 1997, p. 135). As I will discuss in greater detail, the virtual learning context created barriers to cultivating relationships with the girls that I had not planned for when initially designing the program. Because our interactions were relegated to virtual sessions mediated by video conference software, we lost the possibility of engaging in one-on-one conversations in group settings and staying "after class" to further discuss ideas--key ways I would have developed relationships with the girls under pre-pandemic circumstances.

Instead, I pursued relationships with the girls through alternative means such as by delivering supplies for our program to their homes, engaging in text conversations with those who desired further discussion, and welcoming their families to class sessions and one-on-one interviews. In addition, our relationships were fostered around a shared sense of grief for the

Black community during the summer of 2020, a shared and complicated fatigue from being quarantined, and a shared frustration with the way science has been traditionally taught. We discovered these commonalities as the program unfolded, and our relationships strengthened across time. As the instructor, I was intentional about sharing my feelings, agreeing, and offering challenges to participants, while also opening space for them to do the same.

Emergent Themes

The fourth essential feature of portraiture, emergent themes, describes the analysis process that precedes narrative creation: "The development of emergent themes reflects the portraitist's first efforts to bring interpretive insight, analytic scrutiny, and aesthetic order to the collection of data" (Lawrence-Lightfoot, 1997, p. 185). This is where the border crossing between empirical and aesthetic processes begins. Developing emergent themes is an iterative and generative process that includes gathering, organizing, and analyzing the data in search of repetitive refrains, resonant metaphors, and patterns. It facilitates the creation of narrative portraits that seek to authentically represent the participants in the study.

In this study, I began developing initial emergent themes by listening for "repetitive refrains that [were] spoken frequently and persistently" by participants (Hill-Brisbane and Given, 2008, p. 646). I paid particular attention to how participants used metaphors and symbolic expressions (Hill-Brisbane and Given, 2008) to make sense of the program curriculum and the art they created. I looked across the girls' participation throughout the entirety of the program of study, in small group and whole group discussions, during daily art meditations, in the focus group and one-on-one interviews, and in their personal art expressions and video diaries. I did not wait until the culmination of the program to begin documenting emerging themes. I was intentional about capturing nuances about each girl and overall themes right away to ensure no

noticings were lost or overlooked when I went back to review the data during analysis. In my analysis, themes began emerging from the beginning, starting as the girls submitted their applications for participation to the summer program.

Aesthetic Whole

The aesthetic whole is the final product of portraiture. The portraitist uses the emergent themes to weave together the context, the portraitist's and participants' voices, and the relationships developed into the narrative portrait (Lawrence-Lightfoot and Davis, 1997). In Chapter 5, I present three written and visual portraits of participants in this study. As I crafted these portraits I was "reminded of the dual motivations guiding portraiture: to inform and inspire, to document and transform, to speak to the head and to the heart" (Lawrence-Lightfoot and Davis 1997, p. 243). Lawrence-Lightfoot and Davis (1997) signal that it is in the process of creating portraits where a portraitist encounters tension between the blending of art and science, the convergence of analysis and narrative. The work in this fifth feature of portraiture is to develop credible and believable stories that are "authentic, evocative, coded and colorful" (Lawrence-Lightfoot and Davis, 243).

Unlike Lawrence-Lightfoot's (1983) single narrative portrait in *The Good High School*, I present a collection of three portraits of rising 10th grade Black girls in the form of both written narrative and visual text. The three portraits reveal the complexity and diversity of Black girls' creative capacities and abilities to think critically about social structures examined in a science learning space. The narrative portraits presented in Chapter 5 are accompanied by visual representations of each of the three girls, not created to capture a recollection of their physical appearance. The visual portraits, along with the narrative portraits, are designed to present interpretations of their essence and their Black girl imaginations as they presented themselves

during the program. In the following sections, I unpack in more detail the ways that portraiture's pursuit of "goodness" and its five essential features guide the methods of data collection, data analysis, and presentation of findings. I begin with a description of the research context.

Portraitist's Voice

As discussed in the sections on portraiture methodology above, my voice as a portraitist and researcher is integral to the creation of the portraits presented in Chapter 5, and it is revealed in various modalities throughout the study. In this chapter, I spend a wealth of space sharing my positionality so that the reader can clearly distinguish my voice from the voice of the girls in this study, making it clear the ways our identities intersect and converge. Engaging in the summer program via Zoom meant the way I showed up physically to the learning space would be confined by a rectangular box on a computer screen. Things that may normatively be noticed--, height, weight, body movements, personal quirks, etc.-- were somewhat mysterious now that I was only visible from the chest up. Two characteristics that could not be disguised were my Blackness and my womanness. My identity as a Black woman, former Black girl, was most salient throughout the research process, as it motivated my commitment to centering Black girls' stories in my work. It was also a point of convergence for me and many girls in the study. For example, I found myself using the term "we" when discussions of police brutality, discrimination against Black women, and the joys of being Black girls emerged.

I thought intently about how my physical appearance would contribute to our two-week program. I chose not to wear make-up for the entirety of the program. I enjoy wearing makeup and love the creativity associated with applying it to achieve different looks, but for the past 7 years I have struggled with adult acne. Prior to quarantine, makeup was beginning to become a crutch for me; something I felt I needed to look "presentable." As I planned for the program, I

knew I wanted to forego my use of makeup during the program. If one of the goals of this program was to support Black girls in being their authentic selves, I wanted to show up as my whole and vulnerable self. I wore my hair in waist length knotless braids that I had done as a protective style for my medium length natural afro. I wore what I considered to be business casual tops… with a flare. Something that seemed professional, but not too uptight. Most days I chose shirts with fun, bright colors like mustard, orange, and pink. My goal was to be myself and hopefully exude as much energy and joy, virtually.

In addition to the identities that were visibly recognizable, there were also identities that emerged more subversively in my engagement with participants and the research process. What was not so visible through my webcam, but that deeply informed how I show up in any space were identities that are informed by my personal background and educational experiences. I was vocal about pursuing a PhD in education, being a wife, being motivated by my grandmother's legacy, my position as a daughter of a single parent, and my roots as a native of a nearby Mid-western city. In addition, I am an educator and, former high school science teacher. I was also intentional about sharing that I am a trained chemist. This identity is one that takes the background in most settings, but I chose to foreground this identity with the girls as a means of representation and showcasing another example of a Black woman in science.

The virtual environment we shared became one where the girls shared race-related experiences and pushed back on manifestations of racism in the lessons. I doubt these vulnerable opportunities would have emerged during a two-week program if I were white or male. Our shared experiences, particularly during the summer of 2020 created an unspeakable bond that allowed for the sharing of true thoughts. I also shared how I was experiencing Black womanhood and how some of the experiences they shared reminded me of my childhood years. The threads

of commonality between Black girlhood and Black womanhood strengthened our community although it was virtual. Throughout the entirety of this study my personal background and education experience were present. I found myself consistently navigating across them.

Assumptions Held by Portraitist

Not only did I enter this space with personal identities, but I also entered the field of education and educational research with a set of assumptions about Black youth, particularly Black girls. I bask in this work with the non-negotiable assertion that Black girls are diverse, have critical perspectives about the world to share, and are worth being celebrated in our scholarship. [Say how these perspectives inform your work as research, curriculum designer, program facilitator, etc.]

In this study I serve in the role of curriculum designer, program facilitator, and researcher, assuming an insider-outsider role. My intersectional identity and former experiences as a teenage Black girl and my embedded role in the program of study, situates me as an insider in this work. I am not a complete insider because I remained open about my role as a researcher throughout my time with participants. Further, and although we share many similar identities, we do not share identical experiences. My age alone created a barrier, limiting a full insider status for me in our shared space.

My positionality influenced each decision made throughout the research process (from study design to data analysis), including the manifestation of the research context. In the next section, I provide an in-depth overview of the research context.

Research Context

This study is designed to investigate the ways that Black girl imagination emerges in spaces traditionally reserved for the teaching and learning of disciplinary content knowledge

when the environment is shaped to center Black girls. Prioritizing Black girl visibility by nurturing Black girl imagination has the potential to present new understandings of Black girls' experiences in science which can (1) disrupt typical classroom discourses and structures that position Black girls as invisible and hypervisible and (2) elevate Black girls' ways of knowing and being to inform the revolution of science education. In order to pursue the goals of this study and the related research questions, it was critical to identify a context flexible enough to allow Black girls to learn science with such liberation.

As outlined above, the context in which study participants operate greatly influences how participants choose to behave and express themselves (Lawrence-Lightfoot and Davis, 1997). Because of this, context must be understood as more than simply the physical space in which the study occurs; it must also include the social and political terrain that surround participants' lived realities. Further, Lawrence-Lightfoot and Davis emphasize that the context is also shaped by the participants' presence in it. As such, identifying a learning and research context for this study included developing a space that could shift based on the girls' material, social, and political needs. In this section, I provide an overview of the learning environment cultivated in Empowering Girls Through Art and Science. In efforts to fully represent the research context, I also unpack what I am referring to as the *emotional context*, the unseen contextual space that emerged as a result of the social and political influences of the year 2020.

Overview of Research Setting

The study is set in the Empowering Girls Through Art and Science program, an all-girl, critical, informal summer science program. I facilitated the program in July of 2020, during the first peak of the COVID-19 global pandemic in the United States. In the months prior to the launch of Empowering Girls Through Art and Science, most U.S. state officials had instituted

stay-at-home mandates to decrease the spread of the novel disease. These mandates limited in-person gatherings and travel, with exceptions to those serving in essential occupational roles. As a result of the pandemic, what I had originally imagined as a program that would meet face-to-face for three weeks on a university campus, quickly transformed into a remote program where we met virtually for two hours daily, Monday through Friday, for two weeks.

The girls who participated in the program lived in Michigan, a state that was among the most affected by the first wave of COVID-19. By the beginning of the summer, Michigan ranked number one in job losses due to the pandemic and among the top five states with the highest number of confirmed COVID-19 cases in the U.S. Moreover, as COVID-19 tore through the country, it disproportionately affected racial and ethnic minority groups, with high rates of death in African American, Native American, and Latinx communities (Centers for Disease Control and Prevention, 2021). Half of the girls who participated in the program lived in Warren County, where almost 80% of the population identifies as Black or African American. Warren county, the county where Detroit is located, dominated national headlines for much of the summer due to its extremely high number of COVID-19 cases and deaths. By the end of that summer, there had been a total of 44,888 confirmed cases of COVID-19 and 2,938 confirmed deaths in the county. Warren county, and Detroit specifically, became consistently the most affected by COVID-19 in the state. As it did throughout the country, COVID-19 magnified the long-standing racial, ethnic, and economic disparities within Michigan, specifically positioning Black residents at a disadvantage—many without proper healthcare, working in "essential" jobs with the least protection against COVID-19, and in financial positions that left them fighting to survive the loss of income due to the close of businesses.

The girls who participated in Empowering Girls Through Art and Science did so in the midst of this unprecedented level of social upheaval. The program was offered during the summer session of a college readiness program which had traditionally been held in-person across a large state university's campus in collaboration with various departments and university professors. The larger college readiness program has been operational for years and offers a free year-round academic space for students in grades seven through twelve. Student participants must reside in one of three cities surrounding the large Midwestern university with which the college readiness program is associated. The purpose of the college readiness program is to support students and families in early college preparation, academic enrichment, and social development opportunities. Students in the program must maintain a 2.8 academic GPA, be involved in community service, and have plans to attend college. After successfully completing the college readiness program, students are eligible to receive a full-tuition scholarship to the partnering Midwestern university, if they are admitted through the university's traditional application process. As part of the college readiness program, Empowering Girls Through Art & Science was intended to offer science enrichment to help prepare students for their coursework during the following school year. It was also requested that Empowering Girls Through Art & Science would promote the goals of the college readiness program by being a safe space for students to build community during such an overwhelming time in their lives. Because of the COVID-19 pandemic, 2020 was the first year that the summer session was held virtually.

Emotional Context

The study context extended beyond the physical location of instruction to include what participants felt about the circumstances as well. COVID-19 loomed over our Zoom calls and had specific implications for participants, their physical surroundings, and emotional states. The

participants in Empowering Girls Through Art and Science brought many of the worries, frustrations, and grief associated with the effects of the pandemic to our program daily. No one in the group explicitly shared that they had lost a loved one or if their family had experienced job loss, but the inequitable effects of the pandemic on communities of color consistently surfaced in our discussions. It infiltrated many conversations that began with me asking, "How is everyone doing today?" The girls expressed exhaustion at being stuck at home, out of school, and away from friends for months that wore on them more and more as time passed. In addition, many of them were engaging in virtual learning consistently for the first time, so they shared trepidation about joining Empowering Girls Through Art and Science from their homes.

Not only were the participants grappling with the disproportionate effects of COVID-19 on their families and communities, but they were also simultaneously experiencing a great uproar for justice in the wake of the murders of unarmed Black Americans Breonna Taylor, Ahmaud Arbery, and George Floyd. Exhaustion, anger, fear, questions--so many questions--filled the space. Conversations often veered to discussions about the murder of George Floyd, the innocence of Breonna Taylor, and the anger associated with the lynching of Ahmaud Arbery. The emotional context felt like a fog--not a fog so thick that it prevented our work together, but one that was ever present. These events gave our work together a collective purpose. The essential belief and rallying cry that Black Lives Matter framed many of our conversations. We returned again and again to those three words, using, drawing, and writing them continually throughout the two weeks. I did not plan to be offering this program in the midst of an uprising any more than I had originally planned for a global pandemic, but the social and political realities of the summer of 2020 became an essential feature of the context anyway.

Empowering Girls Through Art and Science

Empowering Girls Through Art and Science was an all-girl virtual summer program that engaged rising 10th grade girls in learning opportunities that (a) prioritized the contributions of Black women and girls throughout the histories of science, (b) foregrounded sociocultural scientific issues that are often omitted in formal secondary science curriculum, and (c) used visual art as a form of meditation and as a product for the girls to reflect on program discussions. The curriculum offered daily opportunities for the girls to discuss ways that race, gender, class, socioeconomic status, and age intersect with science. Instead of using typical disciplinary content (e.g., studying scientific phenomena, conducting lab experiments, etc.) as foundation for the curriculum, I focused instructional time on the ways Black people (and Indigenous people) have been included, excluded, and harmed by science throughout history. Driven by the critical shifts (Table 2-1) associated with critical race-informed science education, the goal of this curriculum was to support Black girls in locating themselves and people who looked like them in the histories and futures of science.

Participants joined Empowering Girls Through Art and Science during one of two sessions. The first session, called the AM group, was held in the morning, and ran from 10am-12pm, Mondays-Thursdays. The afternoon session, called the PM group, ran from 2pm-4pm, Mondays-Thursdays. During the two Friday sessions, the AM and PM groups joined together for a virtual movie night (during the first Friday session) to watch *The Immortal Life of Henrietta Lacks* and a virtual art showcase (during the last Friday session) to present the art the girls created across the two weeks. Each of the Monday through Thursday sessions was organized by four daily activities, (1) daily art meditation, (2) activities to explore Black (and Indigenous) people engaging in science, (3) introductions to new forms of art, and (4) personal art expressions and video diary submission.

For many of the girls, virtual learning was new. Some of them had briefly attended virtual school at the end of the 2019-2020 school year, but many had not joined school virtually because their school provided packets of schoolwork for them to complete as they sheltered in place. Our virtual learning environment consisted of a "Zoom room" containing various video boxes to represent individual participants. Many participants kept their cameras turned on, their faces and snippets of their homes visible to the group; but others appeared simply as black squares with their names written in white across them. Although we shared a Zoom room for two weeks, the immediate physical setting for each participant in this study varied because we each joined the program daily from our homes. The girls joined from bedrooms, beds, dining room tables, living room couches, and basements, each of their homes located in different neighborhoods spanning across three cities. Our separate physical contexts influenced participation and presentation of self, by, for example, hindering some girls from verbally participating due to background noise from family members, while encouraging others to participate because joining from their home removed some of the barriers to entry traditionally present during an in-person program.

Centering Black girls and their ways of knowing and being was the priority as I developed this learning space. The curricular topics chosen, the norms and routines, the supplies provided, and the way learning was expressed were all designed to support an environment that is antithetical to traditional science learning environments.

Curriculum

I was thoughtful about the topics discussed during the Empowering Girls Through Art and Science curriculum. Appendix A provides a detailed scope and sequence of the two-week program curriculum, including the daily learning objectives and learning tasks. The curriculum

focused on answering three essential questions and incorporated three learning tasks to support the girls in answering them. Table 4-1 summarizes the three essential questions and accompanying learning tasks. Figure 4-2 includes the slides used to introduce the learning tasks to the girls accompanied by two examples of student work.

The topics of focus during the two weeks were chosen intentionally, as they were guided by key arguments presented in my conceptual framework. Particularly the topics used to guide the Who Done it? Is Science Guilty? learning task were influenced by my critique of Western science using critical race theory and afrofuturism. A critical race-informed science education requires that curricula dismantle the white supremacy innate to the fields of Western science by addressing issues of racism, whiteness, and white supremacy with children in relation to scientific histories and explorations. Womack (2013) argues that within the theoretical space of afrofuturism, Black people must be aware of the social constructs that have been violent toward Black lives, Black culture, and Black histories to imagine new spaces that are not limited by them.

In the Who Done it? Is Science Guilty? learning task, the girls were asked to learn about and briefly describe what transpired during the Tuskegee Syphilis Experiment, eugenics, the sterilization of Black women, and the case of Henrietta Lacks, four examples of the ways white supremacy was operationalized in the doing of science. These topics were chosen because as I sought topics to explore in Empowering Girls Through Art & Science, motivated by my conceptual framing, I searched for topics that would require the girls to utilize their criticality in conversations about science and its relationship with communities of color. I was in search of topics that would call into question the perceived objectivity and neutrality of the fields of science by highlighting the ways harm has been done to achieve a scientific agenda. I was in

search of topics that could fuel the girls' desires to imagine new scenarios of science where Black people were centered, celebrated, and cared for. Logistically, it was important that these were topics not typically explored in mainstream science curricula but were topics that could possibly be familiar to the girls because of the limited time they had to explore them.

In the design and theoretical underpinning of Empowering Girls Through Art & Science, I worked to prioritize learning opportunities that protected and enhanced Black girls' childhood experiences, seeking to not perpetuate the hypervisibility of Black girls through adultifying their learning experiences, which is warned by Black girlhood studies scholars in efforts to maintain the authenticity of childhood for Black girls. There was an odd balance to accomplish while I sought to protect their childhood, but also offer space for their Black girl imaginations, particularly their criticality to be stretched and activated. I ultimately chose to explore the four topics because they each prompted the girls to think of the ways race, gender, and class have influenced how Western science has been deployed in Black communities.

In efforts to mediate their exposure to these topics, I offered resources for their exploration (e.g., videos and website readings) that were "kid-friendly." For example, websites including kiddle.co, kids.brittanica.com, and the educational YouTube channel Crash Course. The resources offered were chosen to present the topics in more "age-appropriate" ways. The explicitness of how the topics were presented was decreased while also maintaining the integrity of history.

It was important that I did not only present the relationship between science and the Black community from a negative perspective during our program. Although the events that transpired in the four key events explored were horrible examples of the ways Black people have interacted with science in the past, Black people have contributed greatly to what we know to be

Western science today. Other learning tasks during the program centered on exploring Black women like Gladys West, Patricia Bath, and Katherine Johnson, all of which contributed to the fields of Western science during their youth and adulthood. Additionally, the girls explored the ways that Black people, Indigenous people, and other people of color were engaging in scientific and engineering exploration prior to Western science being established.

The girls explored Aboriginal medicine and how the Indigenous people of Australia were experts in agriculture and naturopathic medicine for centuries. They explored Adinkra dye and stamps to explore how Ghanaians mastered the chemical processes necessary to create dye used to tell stories on fabrics. Lastly, they explored the mathematical genius required to construct Egyptian pyramids, a phenomenon scientist and engineers are still baffled by today. The learning experiences worked in tandem to present science as an endeavor that was established by people of color, but in many ways was colonized and eventually used to harm the people responsible for its origins. In the limited time with the girls, this was a critical foundation to set in efforts to expand their imaginations of what science is and could look like when challenged by critical race theory and expanded by afrofuturism.

The intersection of art and science were critical to the development of the curriculum. Art and science are often perceived as separate fields, "with one dealing with the expression of feeling and the other with the pursuit of objectivity" (Eisner & Powell, 2002, p. 131). Many deem science as a technical enterprise requiring a special skillset, while the entry point for art is more variable (Eisner & Powell, 2002) In Empowering Girls Through Art & Science, I attempt to combine the two fields in efforts to make the science learning environment more accessible, to nurture opportunities for the girls to be children, be critical, and be creative, and to begin shifting the perception of science away from the stereotypical rigidity. There are students who consider

themselves to be “math and science people” and student who consider themselves to be “English language arts people.” The melding of art and science was also intentional to motivate all types of girls to participate in the program.

The arguments made using critical race theory to challenge the disciplines of science assert that science is much more like science than the field claims it to be. Science is rooted in human decisions and interest, similar to artistic expression. Science is built on interpretation, expression to an audience, and making sense of abstract ideas, similar to artistic expression. In the Empower Girls Through Art & Science, I intentionally embed artist expression as a means of “checking for understanding” in every lesson to begin making these connections between two fields that are considered so unique.

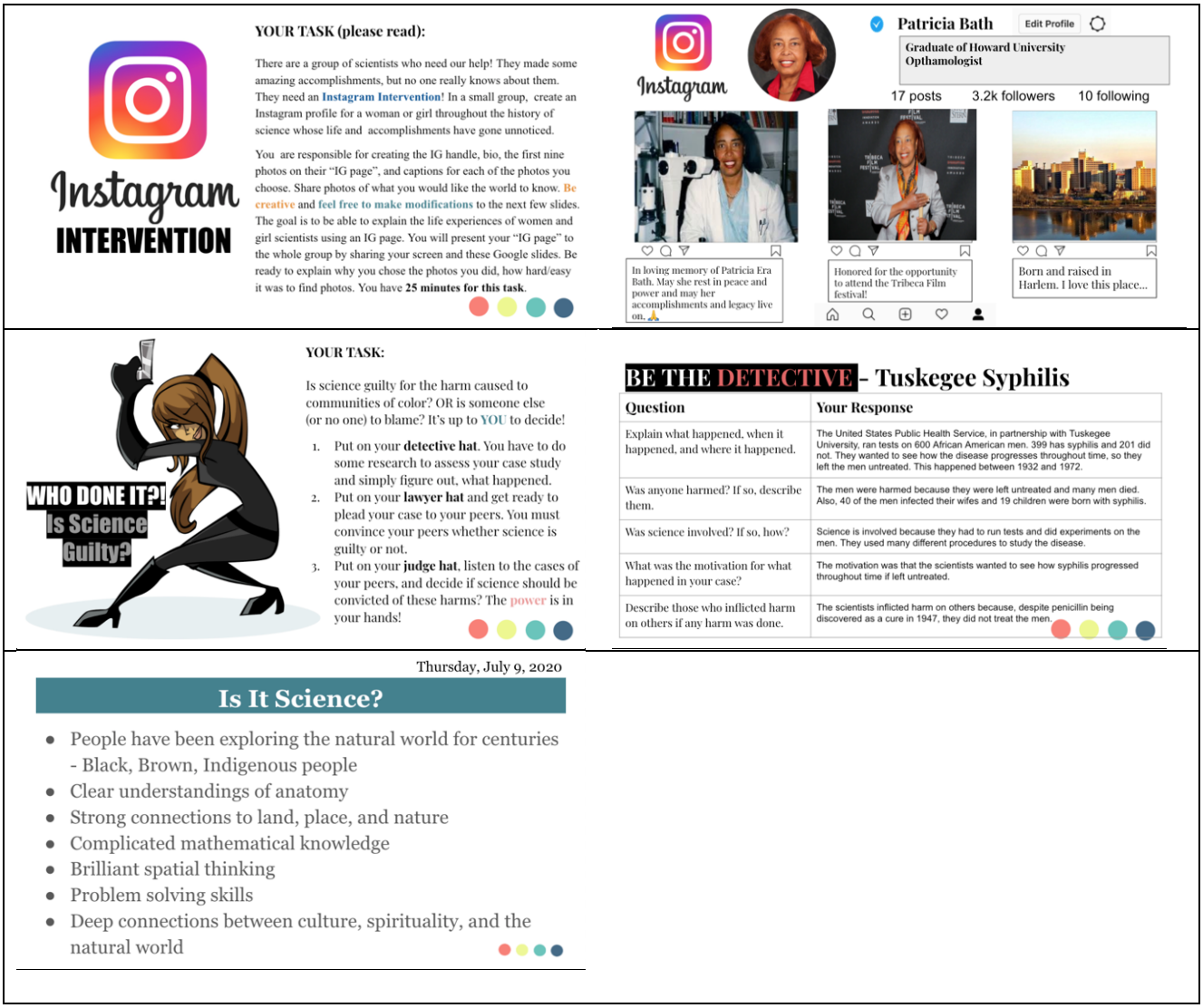
Table 4-1

Essential Questions and Learning Tasks

Essential Questions	Learning Tasks
What have Black women and girls contributed to the development of the fields of science?	**Instagram (IG) Intervention** Small groups were tasked to provide an "Instagram Intervention" to a group of Black women scientists who have made amazing accomplishments, but many people do not know about them. The girls were given the name of one Black woman scientist. They then created the IG handle, bio, chose the first nine photos on their "IG page," and wrote the captions for each of the photos chosen. The task culminated with each small group presenting the accomplishments of their scientist to the larger group. Image # is a screenshot of the learning task instructions and an example of one groups' IG page for scientist Patricia Bath. **Black Women in Science Today –** Black women who were working in the various fields of science joined our virtual session. They sat on a small panel and shared about the work that they do and shared their opinions of what they believe the experience is like for Black girls in STEM today.
Is science guilty for the harm caused to Black people during the Tuskegee Syphilis Experiment, eugenics, sterilization of Black women, and the true story of Henrietta Lacks?	**Who Done it?! Is Science Guilty?** Small groups were tasked to determine if science is guilty of the harm caused to communities of color. If their answer was "no," they were then asked to determine who was to blame. The girls put on their *detective hats* to conduct research on one of the sociocultural scientific issues and decide who is to blame. They then put on their *lawyer hats* to plead their case to their peers. Finally, they put on their *judge hats* to listen to the cases of their peers and decide if science should be convicted of the harms caused. Image # is a screenshot of the learning task instructions and an example of one groups' case files as the detectives.
How have Black and Indigenous people explored the natural world throughout history?	**Learning From the Past** In small groups, the girls conducted research on one of four historical explorations of the natural world by Black and Indigenous people. Research consisted of reading a variety of short articles and watching informative videos together via Zoom. The historical explorations were (1) Aboriginal medicine, (2) Adinkra ink and stamps, (3) Egyptian mummification, and (4) Egyptian pyramids. At the end of their research the girls had to decide if these people were "doing science," including a rationale to defend their answers. Image # is a screenshot of a review of the conversation had with the girls in response to the essential question.

Figure 4-2

Learning Task Slides



Norms and Routines

The norms and routines established for Empowering Girls Through Art and Science prioritized flexibility, agency, and communication. One norm that I established on the first day of the program was to start each session with art meditation. Girls were given a prompt or a question, the materials to use, and the first 20 minutes of each session to freely express themselves artistically. I provided optional time for the girls to share their meditation with their

peers. I also participated in the daily art meditation along with the girls each day and consistently shared my piece of art with the group as a model.

Other norms and routines that we established on the first day of the program were to:

1. Find a comfy place to join the session where you can also engage in art.
2. Come as you are and however is comfortable for you.
3. Laughter and smiling are welcome here. And if you don't feel like it, that's cool too.
4. Share your thoughts because they are important for our work together.
5. Asking questions is celebrated! Feel free to contact me if you get stuck.

These norms were set and agreed upon by the girls during the first couple days of the program and were established to disrupt traditional school and classroom science norms that can be stifling to creativity and imagination. Typical classrooms require students to dress in particular ways (e.g., with shirts tucked in and hoods, scarves, durags, and bonnets removed, etc.) and to physically position their bodies in ways school staff deem acceptable (e.g., avoiding laying their heads on the desks, slouching in their seats, and fidgeting with their hair or supplies). Additionally, laughing is often considered a sign of distraction, and students are expected to avoid it during learning. In science learning spaces specifically, dominant expectations typically position the scientific method and norms of the fields of science as at odds with creativity and personality. These kinds of norms can be stifling to Black girls who may want to express themselves in ways considered unacceptable. The norms in Empowering Girls Through Art in Science were designed to privilege the girls' personal autonomy and agency over their bodies and expressions, hence why the freedom to laugh, wear bonnets, and lay down were norms for our work together.

Art Kits

I gave each girl an art kit at the outset of the program. The art kits consisted of art supplies that could be used during the two-week program and kept after the culmination of our work together. The kits included three printed mandala coloring pages, eight sheets of white cardstock paper, one blank hardcover book, one 4x4 white canvas, crayons, markers, oil pastels, watercolor paints, acrylic paint, paint brushes, a Fujifilm Instax Mini instant film camera, and two packs of Fujifilm Instax Mini film. They were given kits to provide a baseline of art supplies that could be used during art meditation and during the personal art expressions, but they were not required to use them. Many of the girls used iPads, colored pencils, highlighters, and other materials they already owned to create their art expressions. In addition to the art supplies, the art kits also included popcorn, cookies, juice, and other snacks for the girls (and their families) to enjoy during our movie night.

Due to COVID-19 restrictions, the art kits had to be mailed or delivered to girls' homes. I chose to personally deliver an art kit to each program participant. Due to the remote nature of our program, delivering the art kits allowed me an opportunity to meet the girls in person, although these moments were short and socially distanced. These opportunities were integral to developing relationships with the girls. As previously described in the five features of portraiture, the relationship between the portraitist and participants is critical in developing the most authentic representations in the portraits. I wanted to take full advantage of every opportunity I had to break down the barriers that organically exist when meeting someone for the first time and only engaging virtually.

Personal Art Expressions

The girls were assigned six personal art expressions to be completed throughout the duration of our program. For each art expression I provided prompts, a list of suggested materials to use (they were also encouraged to use whatever materials felt best to them), and video links that described the historical context of the art technique or tutorials of the technique. The six techniques were (1) Jean Michel Basquiat inspired illustrations, (2) graffiti as protest, (3) photovoice, (4) Aboriginal dot painting or Adinkra symbols, (5) self-portraiture, and (4) children's book or comic strip. The prompts were relevant to the discussions we had during the daily sessions. A list of artistic expression prompts can be found in Appendix B. For example, on the second day of the program the curriculum focused on what it means to be a Black girl in America and the diversity within Black girlhood. The prompt for that day's personal art expression asked the girls to create a piece of art that expressed what it feels like to be a Black girl in society today using Jean Michel Basquiat's artistic technique as inspiration.

Core Research Artifacts

My three research questions guided the artifacts gathered during data collection. The first research question was designed to identify and analyze how Black girls' reveal their Black girl imaginations through program discussions and artistic expression. To answer the first question, I collected artifacts of their artistic expressions, video diaries created to explain their artistic expressions, field notes from my observations of all ten sessions, and researcher memos. The second research question was designed to analyze how Black girls use their Black girl imaginations to articulate characteristics of themselves. To answer the second research question, I collected program applications, formal semi-structured interviews, artifacts of artistic expressions, and video diaries. The third research question was designed to analyze how Black

girls actualize their Black girl imaginations to make sense of and ask questions about science. To answer the third question, I collected surveys, program applications, field notes from my observations of their program participation, and focus group interviews. Before discussing each of the artifacts in detail, I share who the participants are in this study and how I recruited them to participate in Empowering Girls Through Art and Science.

Participants

To recruit participants, I created a flyer and informational video (Appendix C) for Empowering Girls Through Art and Science that was distributed via email to families currently participating in the college readiness program. Announcements were made at three of their virtual family nights for their summer session. Family nights were the most effective venue for recruitment. After each family night, I received an influx of interest in the program. To be considered for participation in Empowering Girls Through Art and Science applicants had to be a rising 10th grade girl, submit a complete and proofread application, and commit to attending all ten virtual program sessions. For the application to be considered complete, all questions had to be answered and students had to indicate if they were interested in participating in a research study. Participation in the research study was not a requirement for participation in the program. All those who applied were admitted to participate. Twenty-six girls from the college readiness program applied. Of those who applied to be in the program, 22 consented to participate in the research study.

Although the study was designed to explore the experiences of Black girls, state regulations prevented academic programs from only opening participation to a certain racial demographic. At the same time, the goals of the program were clear. I was transparent that the topics discussed would center Black women and girls and the history of people of color

throughout the histories of science. The curriculum was designed to nurture Black girl visibility, but girls who identified as Hispanic/Latinx or white were also eligible to apply. Of the 22 girls who consented to participate in the study, 16 identified as Black/African American, one as biracial (Black and white), three as Hispanic/Latinx, and one as white (specifically identified ethnically as Middle Eastern). Due to the purpose of this study, data collection focused on the participation of the 16 Black and one biracial participant. Table 4-2 provides a list of the 17 girls included in the overall study, which group they participated in, and the data collected from each of them. The racial demographics listed were taken from the girls' responses to the program application.

I entered the first day of the program not knowing who the focal participants of the study would be. I was open to get to know all the girls and build authentic relationships with them even though our time together was short, and the context was unusual for them and for me. Because of my limited time with them, it was imperative that I found small pockets of time to talk with them, share laughs with them, listen in on their small group conversations, look closely at their artistic expressions, and watch their video diaries intently.

There were a few girls (Beane, Bella, Ebony, Lena, and Noelle) who rarely ever showed their faces on camera and remained muted for most of the program discussions. Understanding who they were and how they grappled with the program topics was difficult, but it required that I relied on their artistic expressions and video dairies to make claims. These same participants had limited artistic expressions and video diaries, which made getting to know them even more challenging. Although some themes and noticings were made from the limited data received, I struggled to triangulate and make robust claims about these girls and their Black girl imaginations with fidelity. One critical goal of this study was to center Black girl voice and to

elevate how Black girls define themselves and share their thinking about the world. It became difficult to center Black girl voice when the girls were limited in offering their voice during the study. In another virtual learning environment where I had more than 20 hours total to spend with them, I would have been able to offer one-on-one office hours or set up consistent get-to-know-you phone conversations with them and their caregivers to increase my understanding of who they were and how they expressed themselves.

For the data I did receive, I explored the artifacts provided by the girls and their participation in the course as a collective set of data, first. I was in search of the ways the girls talked about themselves in relation to their childhoodness, criticality, and creativity. I also explored how they grappled with the topics discussed in the program. I was able to identify themes in how the girls were conceptualizing their own childhoodness, exercising their criticality, and expressing themselves creatively. I observed that some aspects of childhoodness, creativity, and criticality were foregrounded with some and backgrounded with others.

After I collected and coded data from all 17 participants who identified as Black or biracial, I chose Chloe, Jordan, and Elaine (all pseudonyms) to be the focal participants for my narrative portraits because (a) they comprise three diverse representations of Black girlhood, and (b) their expressions of Black girl imagination are rich and apparent throughout the two weeks. Together, they highlight all aspects of my conceptual framework in nuanced ways. I offer more detail about the process of choosing the three focal participants later in this chapter in the *Data Analysis and Synthesis* section. Chloe, Elaine, and Jordan all participated in the PM group of Empowering Girls Through Art and Science, which was the section of the program that was made up of 100% Black girls. Although the girls in both groups brought in their racial

experiences to discuss program topics, I focused on the PM group because it seemed to me that they were able to have more transparent conversations about race than the AM group.

Table 4-2

Study Participants

Pseudonym	**Race** (Self-Identified)	**AM Group or PM Group**	**Participated in Focus Group**	**Participated in Semi-Structured Interview**	**Artistic Expressions Received** (Out of 6)	**Video Diaries Received** (Out of 6)
Ari	Black and white	PM	Yes	-	6/6	5/6
Beane	Black	PM	Yes	-	0/6	0/6
Bella	Black	PM	Yes	-	2/6	0/6
Breonna	Black	AM	Yes	Yes	6/6	2/6
Cheyenne	Black	AM	Yes	Yes	3/6	3/6
Chloe	Black	PM	Yes	Yes	5/6	2/6
Ebony	Black	PM	Yes	-	2/6	1/6
Elaine	Black	PM	Yes	Yes	6/6	6/6
Jordan	Black	PM	Yes	Yes	5/6	3/6
Lena	Black	AM	Yes	-	1/6	0/6
Makayla	Black	AM	Yes	-	5/6	5/6
Maria	Black	PM	Yes	Yes	6/6	6/6
Noelle	Black	PM	Yes	-	2/6	2/6
Quinn	Black	AM	Yes	Yes	3/6	0/6
Sabrina	Black	AM	Yes	Yes	4/6	4/6
Simone	Black	PM	Yes	Yes	6/6	6/6
Shayla	Black	PM	Yes	Yes	3/6	3/6

Note. The highlighted participants are the focal participants used to inspire portraits written in Chapter 5.

Artifacts

I collected the following six artifacts to compose the portraits: (1) participant program applications, (2) my field notes from participant-as-observer observations, (3) focus groups, (4) formal semi-structured interviews, (5) video diaries, (6) artifacts of artistic expressions created during the program.

Participant Program Applications

I created an online application that the girls had to complete to be considered for participation in Empowering Girls Through Art and Science. The application (Appendix D) had a total of 13 questions. The first nine questions collected demographic information from each applicant, including gender, race/ethnicity, age, grade, name of high school, previous science classes taken, and science classes they plan to take in the upcoming academic year. Each of the final three questions had multiple parts and therefore comprised a set of questions (3 sets total). The first set of questions were designed to inquire about what the girls considered to be their own strengths and areas of growth. The second set sought to assess their experiences with and thoughts toward science learning inside and outside of school. The third set of questions inquired about what they hoped to gain from and offer to Empowering Girls Through Art and Science.

Applications were open for three weeks, with a submission deadline a month before the start of the program in July. The application was created using Google Forms, so the information collected from each applicant was converted to an excel document, which became a master spreadsheet throughout the program where I took attendance, recorded pseudonyms, and referenced as I planned each daily session.

Field Notes from Participant-as-Observer Observation

As discussed in greater detail below in the section on my Portraitist's Voice, I participated in Empowering Girls Through Arts and Science in a variety of roles. I was the program developer, curriculum designer, program facilitator, researcher/portraitist, and all the while, a Black woman and former Black girl. I navigated these various identities consistently throughout the program, which resulted in me assuming a participant-as-observer perspective during daily sessions. Participant-as-observer observation is a method wherein the researcher

fully participates in the ongoing activities of the research setting, and members of the setting know the individual is there to conduct research (Hesse-Biber and Leavy, 2011). Gold (1958) identifies levels of participation in the field, with participant-as-observer being the second most involved role a researcher can have with participants and the research setting. Participant-as-observer observation yields knowledge about participants and the setting by observing and participating in what naturally occurs at the research site.

Because I fully participated during the daily sessions, it was difficult for me to take field notes in-the-moment. To avoid having to step in and out of facilitator and research perspectives, I fully assumed the role of the facilitator during the program in real time. I video recorded each of the sessions and watched them back immediately after they concluded to view the activities from a researcher perspective and to write my daily field notes. Engaging as a participant-as-observer enabled me to make connections between the intentions of the curriculum design and how the girls responded to daily activities. I was also able to modify the curriculum based on how the girls were grappling with ideas. In addition, in my role as participant-as-observer I was able to see the girls' homes as I delivered program supplies, which helped to create even more nuanced representations of the girls in the narrative portraits.

The virtual setting made it feel more challenging to fully immerse in the research setting and meet the demands of research guided by portraiture. However, my role as participant-as-observer meant I received emails, calls, and daily texts from the girls if they had questions, as well as speaking with parents and building rapport with the college readiness program staff. These features of my role strengthened my observations and field notes based on the two hours I spent with the girls each day. I documented all field notes using a notebook that was labeled with the date, session (AM or PM group), and referenced the girls using their pseudonyms.

Focus Groups

I conducted two focus groups, one in each of the two program sessions, on the first day of Empowering Girls Through Art and Science. Focus groups are a form of qualitative interview but differ in that multiple participants are interviewed simultaneously (Hesse-Biber, 2011). Focus groups offer an opportunity for participants to not only respond to the questions posed by the researcher but also to respond to one another's contributions (Hesse-Biber, 2011). Focus groups promote conversation. At the same time, although they can be dynamic and unpredictable, they do not typically occur as natural talk would because they are guided by predetermined topics or questions. Despite the fact that I intended to develop portraits of the girls individually, I chose to conduct focus groups to help promote conversation among participants and foster group rapport. I also used the focus group to help guide the later one-on-one interviews with me.

Each focus group was guided by a protocol (Appendix E) that outlined questions designed to surface how the girls perceived themselves as well as their thoughts on science and the imagination. The focus group discussions captured moments where participants asked questions of one another and moments when they modified their perspectives based on others' contributions.

Formal Semi-Structured Interviews

I conducted six one-on-one, semi-structured interviews two weeks following the close of the program to capture the girls' thoughts about their experiences there. I made the request to participate in the interviews with me to all research participants via text. Of the 21 girls who had initially consented to participate in the study, six volunteered to meet with me for 30 minutes.

Given the age of the participants and the climate of the world, I opted to keep the interviews short so as not to exhaust them and to be respectful of their daily routines.

The interview was designed to capture the girls' overall reflections on the program and gauge if (and how) their perceptions of science had been influenced by their participation in the program. Although I entered the interviews with a semi-structured interview guide (Appendix F) to ensure consistency in the data across subjects (Patton 1990), the nature of semi-structured interviews allows respondents some latitude and freedom to talk about what is of interest or importance to them (Hesse-Biber, 2011). My goal was to allow the conversation to flow as naturally as possible, even if that meant the conversation took detours, while simultaneously allowing the predetermined questions to gently guide.

Each interview began with me checking in with them about their well-being since the conclusion of the program. I then spent the bulk of the interview with them discussing (1) what they found most memorable about our program; (2) their opinions on the influence race/ethnicity, gender, class, age have on participating in the fields of science; (3) their favorite art expression to create; and (4) their definitions of imagination. All the topics were discussed with each interviewee, but the order of the topics differed based on their responses. These interviews were conducted virtually using Zoom. In cases where the internet connection was inconsistent, the interview took place over the phone, but I still recorded the conversation using the Zoom platform. Three interviews were conducted one-to-one and in the remaining three interviews participants were joined by a parent or a sibling.

Artifacts of Artistic Expressions

Collection of visual texts. A key component of this research study was to support the creative capacities of Black girls by providing opportunities for them to express themselves

artistically. I also chose to incorporate consistent opportunities for participants to express themselves artistically to push back on normative and typically accepted means of conveying learning. The development of visual texts--texts created using visual media (paint, drawing, collages, photographs, and so on) --is an anchor to this study because unspoken language can be embedded within artistic expression, which can be read, responded to, and the source of critical conversation (Albers, 2007). Artistic expression is a form of communication that does not require words but can convey powerful messaging just the same (Albers, 2007). Particularly in a study that centers the perceptions of Black girls, using the creative capacities of Black girlhood as a frame can promote critical reflection on how their perspectives, lives, and stories are influenced by or push back on systems and institutions designed to disenfranchise or marginalize them (Brown, 2013).

Participants had the opportunity to complete and submit six artistic expressions. Each artistic expression was chosen to reflect a different way people of color across time have used visual texts to tell stories, protest, pass down cultural knowledge, and express themselves (described in detail above in the section Personal Art Expressions). Each art expression was relevant to that day's lesson, came with a prompt and reflective questions, and included a list of suggested supplies to use and videos to watch. The artistic expressions along with video diaries were products that the girls were expected to complete outside of the two hours we shared together daily.

Video diaries. I collected six video diaries from each participant. These video diaries were a supplement to the artistic expressions they submitted. Not all participants submitted all six videos. The video diaries had associated discussion questions to guide participants in reflecting about the art they created. Video diaries provide more of a direct understanding of

participants' experiences without having the researcher physically present (Gibson, 2005). I was not completely removed from this form of data collection because I provided prompts; but the prompts acted as suggested talking points to guide their reflections, and they were free to comment on any aspect of their art that they chose. I decided to collect video diaries in addition to visual texts to add complexity to my analysis. The girls' video diaries offer some explanation about the meaning of the art they created, including their rationales about the artistic decisions they made and their emotional responses to creating the art. Many girls approached the recording of their video diaries as if they were recorded YouTube videos, with some of them having intros and outros.

Data Analysis and Synthesis

Similar to the development of narrative portraits, the process of qualitative data analysis is, "intellectual craftsmanship" (Mills, 1959, cited in Tesch, 1990. p. 96). As Renata Tesch states, "qualitative analysis can and should be done artfully, even 'playfully,' but it also requires a great amount of methodological knowledge and intellectual competence" (1990 p. 97). In this study, I analyzed the data intentionally to craft robust narrative and visual representations of three girls. To do so, I combined a variety of data analysis methods, similar to the artistic process of creating a mosaic, to develop an analytic process capable of accommodating the diverse forms of data I collected (i.e., data derived from visual, written, audio, and video recorded sources of data) to respond to my research questions.

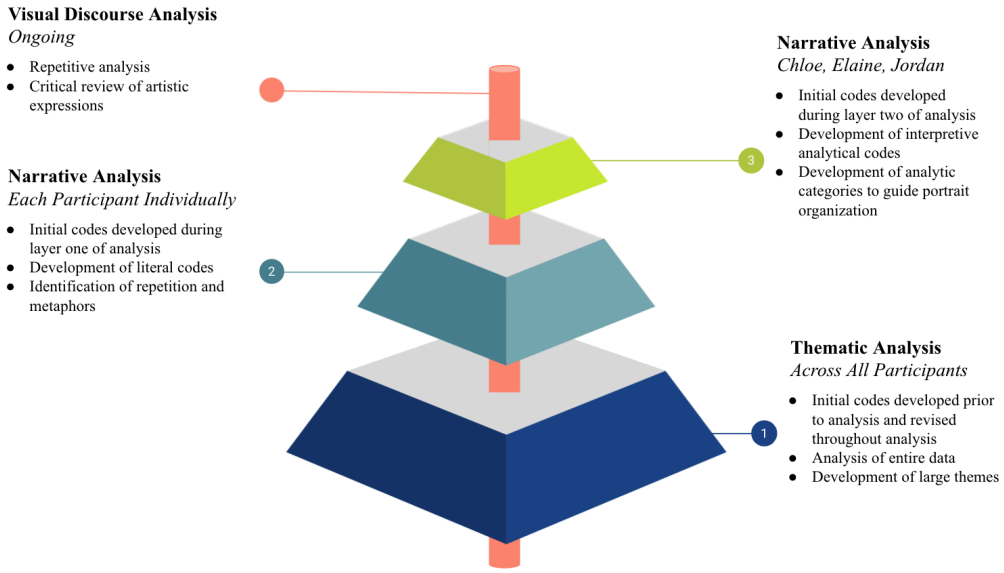
My analytic methods comprised thematic analysis (Braun & Clarke, 2012), narrative analysis (Cortazzi, 1994), and visual discourse analysis (Albers, 2007). Figure 4-2 represents the ways that I organized each of these methods into three layers of analysis: thematic analysis as the first layer, narrative analysis as the second and third layers, and visual discourse analysis

happening iteratively across the three layers. I consider them layers because as I applied each method of analysis to the data set, I was able to derive a clearer, more nuanced representation of my focal participants, Chloe, Elaine, and Jordan. Although figure 4-3 represents the layers as discrete and sequential, my actual approach to synthesizing the data was iterative, and I moved back and forth between the layers frequently to better understand each girl's representation of self and meaning making of science during the program.

Elevating participants' voices is an essential component to portraiture as well as to the conceptual underpinnings of my research questions. As such, interviews with the girls, their video diaries, and their artistic expressions were foundational to this study. In addition, the pursuit of "goodness" that anchors portraiture (Lawrence-Lightfoot & Davis, 1997) also anchored each layer of analysis, guiding my development of coding schemes and my navigation within each analytic method.

Figure 4-3

Layer Data Analysis



Layer 1: Thematic Analysis

Each layer of my analytic process was guided by a specific codebook that I developed for that layer and continuously refined throughout the study. The first layer, thematic analysis, was the foundational layer for all subsequent analyses. I began by conducting a thematic analysis of the data set as a whole. I revisited my research questions, conceptual framework, and literature review to develop a thematic codebook of priori codes/themes shown in Table 4-3. The priori codes/themes were developed using key arguments made in the conceptual framework and based on preliminary analysis during data collection.

My articulation of Black girl imagination necessitated the codes *childhoodness*, *criticality*, and *creativity*. These three codes were necessary to identify the ways Black girls' unique imaginations were being expressed. The theoretical lens developed from the intersections of Black girlhood studies, critical race-informed science education, and afrofuturism acknowledges that when we seek to center Black girl voice, we are able to learn more about their experiences as children, their critical views of the world, and their evolving creative expressions. Particularly for coding, imagination is difficult to quantify. Using childhoodness, creativity, and criticality offer tangible moments to capture as Black girls work through the curriculum and share their meaning making. Together, childhoodness, criticality, and creativity offer a view into how Black girl imagination manifests in a science learning environment. I entered this layer of analysis in search of how the girls expressed or did not express their experiences as children, examples of them being critical of science and society, and how they referenced themselves in relation to creative expression.

Table 4-3

Layered Analysis Codes

Layer 1: Thematic Analysis	Layer 2: Narrative Analysis	Layer 3: Narrative Analysis	Ongoing: Visual Discourse Analysis
Initial Codes/Themes: • Black Girl • Childhoodness • Creativity • Criticality • Expertise of Self • Formal Science • Imagination • Interwovenness of Past, Present, & Future • Racism • Visibility • Whiteness Added Codes: • Black Women • Colorism • Defining Science • Familial Connection • Facilitator Feedback • Program Feedback • Virtual Learning	Layer 1 Refined Codes/Literal Codes: • Black girls support each other. • Comparison • Confidence • COVID/Quarantine • Familial Connection • I like being a Black girl • It's the color stuff too...(Colorism) • Relationships with other Black girls • Science is Guilty • People Do Science • Visibility of Black woman • Wanting to reach back and help other Black girls • White washed	Interpretive Analytical Codes • Beauty & Diversity of Black Girlhood • Black pride • Colorism • Conceptualization of time • COVID-19 • Expertise of self • Generational Connection • Intersectionality • Perception vs. Reality • Systematic Science	• Color Use • Connection To Artist's Identity • Literary Discourse Signmakers - Signals to teachers' directions or earlier experiences with texts • Macro Conversations - race, racism, sexism, whiteness, consent • Micro Conversations - Henrietta Lacks, Crown Act, construction of Egyptian pyramids • Placement And Structure of Objects • Repetition • Use of Symbols • Use of Words

I operationalize afrofuturism in this study to expand the typical conceptualization of science by centering Black people thriving across time despite anti-Black racism. The arguments made using afrofuturism motivated the priori codes *interwovenness of past, present, future*, *imagination*, *future*, and *redefining science*. Critical race-informed science education prompted the inclusion of priori codes *Western science*, *racism*, and *whiteness*. These codes were confirmed codes because the girls referenced race, racism, and "white people" often during the program and I knew during data collection I wanted to come back to those contributions during data analysis to identify if there were themes across the data. The maintenance of Black girl childhood, supported by Black girlhood studies, motivated the priori codes *Black girl*, *expertise of self*, and *visibility*.

I began my thematic analysis prior to day one of Empowering Girls Through Art & Science. As I received applications, I began writing "impressionistic records" (i.e., researcher memos) and documenting early interpretations, analyses, and themes that I planned to return to

once I was able to analyze the data as a complete set (Lawrence-Lightfoot & Davis, 1997, p. 188). I continued to create impressionistic records throughout the data collection process.

During thematic analysis, I used the priori codes to review the data by artifact. I looked at all the program applications together, all of the interviews together, and all of the video diaries together. I then used the priori codes to explore the data set as a complete collection, not yet organized by participant. I began by exploring the interview and focus group transcripts, field notes, and program applications. I read through each data source thoroughly, coding each sentence, word, or phrase. I paid particular attention to the initial priori codes while also documenting new codes as they became relevant. I analyzed the visual artifacts after the text-based artifacts. As I analyzed the visual artifacts, I paid particular attention to the words written, the colors used, the boldness of the images, the location of the images, and the images themselves. I coded the visual artifacts by writing an attached memo. I then watched the associated video diaries to add nuance to my interpretations and to confirm the purpose and meaning of the art created.

During this layer of analysis, I was able to look across the data set of the 17 Black girls who participated in the study to identify themes that were present and which ones were not. For example, a priori theme I set out to explore during the first layer of analysis was *redefining science*. As I explored the data, I did not see any evidence of this code across the data. This is likely because there were not discrete opportunities in the program curriculum for the girls to redefine science. They were only grappling with *defining science* as it currently is. This finding caused for me to add the new code, defining science, to the list of layer one codes.

There was a wealth of knowledge gained from the girls' participation in daily discussions, but during the first layer of analysis I was intentional about also exploring their

artistic expressions, video diaries, program applications, and semi-structured interviews. By looking at these data sources, the themes identified in their daily participation were confirmed, contradicted, or became more nuanced. For example, across the transcripts of daily participation, it was clear that the girls were grappling with the ways anti-Black racism influenced their lives and the lives of their families. They spoke about anti-Black racism in reference to the legal system, police brutality, and the lack of progress toward racial justice in the U.S. When I explored the data set beyond their daily participation, I began to see how they were identifying the need to fight against anti-Black racism, but additionally they were discussing the ways colorism is also affecting the Black community, internally. My understanding of how the girls were making sense of their race expanded by exploring the data set as a whole and not elevating daily discussions above the other data sources. Each piece of data collected was critical in identifying the large themes that existed across the data, especially the data that was produced outside of our daily program discussions.

In addition to identifying themes in the data based on what data the girls provided, there were opportunities for me to identify themes in the data based on the data that was not there. As mentioned in early in this chapter, there were girls who rarely turned their videos on or unmuted themselves. These girls were expressing themselves by not turning their cameras on and choosing when and when not to participate. There are themes that could be identified and claims that could be made about the girls who were visibly and audibly absent during the program. For this work, and for the construction of the portraits, I chose to focus on what I was able to hear and see, and not try to analyze what I did not have access to.

Layer 2: Narrative Analysis

When I began my second layer of analysis, I reorganized how I reviewed the data. I organized the data by participant. For example, I revisited all of Chloe's data as a collection of data (including all her artistic expressions, her video diaries, her participation in the daily sessions, etc.) using the initial codebook. As I was analyzing each girl's set of data, new codes emerged. Depending on how each girl specifically spoke, behaved, or created with respect to the thematic codes, I specified and refined those codes to reflect the girls' narratives. For instance, the initial thematic code *defining science*, but during this first layer of narrative analysis that code became more refined and evolved into two codes--*in-school science* and *science is just a tool and you can't blame the tool for how people use it*--based on the girls' data. Table 4-3 represents the ways I specified and refined the initial codebook after conducting the first layer of narrative analysis of each girl's individual set of data. The refined codebook for layer two consisted of mostly "literal codes" (Hesse-Biber & Leavy, 2011, p. 311), meaning the codes were made up of exact words or descriptions from the artifacts.

Identifying Focal Participants

The transition from layer 2 to layer 3 was a critical moment in the data analysis process because this was where I chose who would be the focal participants for the narrative portraits. By analyzing the data sets by participant during layer 2, I noticed key themes that existed between the girls. One theme that was apparent in a majority of the girls' data sets was the girls' abilities to recognize limitations, see boundaries, identify resistance against them, and deeply feel the lack of progress made for Black people and Black girls. They spoke about, wrote about, and created artistic expressions differently to express these limitations, but almost every girl referenced some sort of boundary placed in front of Black girls and Black people. Additionally, those same girls

were very expressive about how they chose to exist beyond the things they articulated as being limiting. In their expressions of limitations, they revealed variation in the ways they experienced childhoodness, criticality, and creativity.

Some of the girls articulated the limitations and existing beyond them by describing their relationship with time and their perceptions of how the past, present, and future interact to produce a hope for change. Other girls expressed this theme by pushing back on the physical expectations that Black girls encounter as society attempts to determine what is acceptable presentation of Black girls' aesthetic. There were a couple girls who expressed this theme by sharing their ability to overcome a fear of the future, not really knowing what career they wanted to pursue, yet understanding they are only children, and they are not required to have their futures determined.

This theme exposed how there were girls who unapologetically existed as children, some who were fighting to maintain their childhood, and others that conflated themselves as children with them also being adults (interchanging Black girl with Black woman). This key theme also revealed how all the girls expressed critical perspectives about the world, but the language used to describe that criticality varied. Some girls shared their critical lens from only personal experience. Others used language signaling they had listened to, watched, or read work from educators and scholars who theorize about racism in the U.S. Although each of their articulations varied in complexity, they were all meaningful and representative of who the girls were and their ideas of the world. Lastly, the girls' creativity was primarily revealed in the opportunities they had to be creative. So much of their unique personalities emerged in the artistic choices they made, how they interpreted their own art, and the ways the art confirmed or offered nuance to their other sources of data.

I could have chosen many girls as the focal participants for this study because of the variety of data provided. I chose Chloe, Elaine, and Jordan for a host of reasons. I chose Chloe because she brought great joy to the program. Her energy was infectious and integral to the PM group. She also offered a criticality that came from a 14-year-old child-like perspective. It was nuanced in meaning, yet in articulation, organic from her own personal opinions about the world. Elaine was representative of the group of girls who offered a more subtle presence to the program, which was just as meaningful as those who required more attention. She used her artistic expressions most frequently as a language to further communicate her thoughts. She was chosen as a focal participant because she consistently came back to the limitations, she identified and existing beyond those limitations, a key theme across the large data set. Finally, Jordan was chosen because of her unique presentation of criticality and expressions of childhoodness. As a youth activist, participating in protest and educating herself about racial injustice was integral for her coupled with her desire to play volleyball and hang out with friends. She represented a type of Black girl whose childhood was steeped in activism, and it motivated her. Chloe, Elaine, and Jordan had various themes in common, but were chosen because of the nuanced ways they represented Black girlhood and many of the arguments made in my conceptual framework.

Layer 3: Narrative Analysis

For my third layer of analysis, I conducted another narrative analysis, this time focusing only on my three focal participants, Chloe, Elaine, and Jordan. In this narrative analysis, the literal codes from layer two guided my review of the focal participants' individual data sets. However, as I began developing nuanced interpretations of how each of the three girls expressed their Black girl imaginations, the literal codes evolved into "interpretive analytical codes" (Hesse-Biber & Leavy, 2011, p. 311). These interpretive analytic codes reflected broader themes

that were present in each of the girls' data sets, but that emerged in unique ways as a result of their unique experiences.

I then took the layer two codes and condensed them into a list of most prominent codes that repeatedly emerged across all three data sets. From these, I created analytical categories that I then used to generate the theoretical concepts which guided my organization of the narrative portraits in Chapter 5. For example, the literal code *science is just a tool and you can't blame the tool for how people use it* was present in each of the girls' data sets. I used the data presented within this theme to articulate their criticality and their meaning making of science. In addition, there were other ways that the girls spoke about science as an enterprise that could be used for harm and for good. Because each of the girls had particular expressions about science, I developed the analytical category *science is systemic* as the interpretive analytical code to capture the complexity of ideas shared across each of the three data sets.

In the third layer of analysis, I was particularly in search of evidence of repetition and metaphor within Chloe's, Elaine's, and Jordan's data sets. In portraiture, the portraitist is tasked with identifying any refrains that appear frequently across a participant's set of data that convey consistency in perspectives (Lawrence-Lightfoot & Davis, 1997). For example, one refrain repeated across the data was *Black Lives Matter*, and it appeared in a variety of data sources by Chloe, Elaine, *and* Jordan. The repetition of this idea across data sources and throughout the two weeks signaled its importance to the girls. Regarding metaphors, the portraitist seeks to identify the uses of symbolic phrases or visual representations that participants utilize to convey a complicated feeling or experience (Lawrence-Lightfoot & Davis, 1997). For example, in this study, Chloe and Elaine both relied on metaphors to describe their perceptions of the neutrality of science. Chloe compared science to an untrained dog and Elaine used the metaphor of a

misused pencil to describe the potential harm of science when left in the wrong hands. These metaphors illuminated the girls' perceptions of science and bolstered my interpretation of the diverse ways specific codes emerged in the data. Not only did the girls specifically talk about science, but they also used metaphors to further expand their particular understandings of science. This confirmed the relevance of my *science is systemic* code.

Using narrative analysis pushed me to listen closely to each girl as she told stories and talked about her experiences. I also looked intently at the artistic expression and accompanying video diaries. Analyzing the ways each girl told stories and the stories each chose to share helped me to create more context-specific representations for Chloe, Elaine, and Jordan. The third layer of analysis greatly contributed to the development of the narrative portraits and guided how I represented each participant and their expressions (or lack thereof) of childhood, creativity, and criticality within their *Black girl imaginations*.

Visual Discourse Analysis

Across the three layers of analysis, I also conducted repetitive rounds of visual discourse analysis (VDA) of the visual texts created by participants (Albers, 2007). VDA is an analytic approach that centers the understanding that embedded in every visual text is a language the viewer can interact with. Visual texts are defined as texts developed using visual media (paint, collage, drawing, clay, photographs, etc.), so I utilized VDA in this study to analyze the girls' artistic expressions. VDA values artistic expression beyond whether something is beautiful or nice, requiring viewers to conduct more critical readings of visual texts to gain deeper understandings (Janks, 2000). I am influenced by the analysis approach of visual discourse analysis in this study. I did not fully embrace the method or use it to its full capacity. VDA was

utilized to enhance my understanding of the students' artistic expressions and to support triangulation across various data source modalities.

Because the girls' artistic expressions were central to the study, I was guided by VDA to analyze the girls' artistic choices, including the words used, the most prominent colors, the size and position of words and objects, repetition within and across pieces, and the use of space on the page. I was in search of evidence of macro/micro conversations surrounding the art creation, use of symbols, and connections to the artist's identity. Evidence of macro/micro conversations was any attention paid to the sociopolitical context that existed in the world that could contribute to the messages the girls were communicating in their art (Kress & Van Leeuwen, 2006). For instance, *Black Lives Matter* was a clear macro conversation that was evident in their artistic expressions.

Across the layers of analysis, as I reorganized the data set and refined the codes used to guide analysis and synthesis, my review of the visual texts evolved. I began to see that "the text creates the context as much as the context creates the text" (Albers, 2007). For example, some of the first Basquiat-inspired expressions revealed the pride and resilience of Black girlhood, and as the study continued, those sentiments became driving forces in the girls' presentations of self. Visual discourse analysis worked in tandem with the layers of thematic and narrative analysis to offer fuller images of Chole, Elaine, and Jordan presented in visual and narrative portraits in Chapter 5.

Analysis Example

To further explain the layered analysis, I will follow the analytic process from the first layer of thematic analysis to the third layer, including how I conducted visual discourse analysis of related artistic expressions. In this example, I follow the coding trajectory of *defining science*

→ *people do science* → *systemic science* to showcase the analytic process. During my initial layer of thematic coding, I coded a variety of occurrences in which the girls attempted to define science in their own terms. For example, in her program application Sabrina wrote,

> I love that everything that happens in science has a reason/cause and relates to other things. I particularly like that science is based on rules, theorems, and principles that can be applied to the past as well as help us gain a better understanding of the present and future. On the other hand, I like that science is always evolving and people make new discoveries all of the time.

During her one-on-one interview, Chloe said, "I never really thought that medicine would be considered science. I would just think, oh yes, it's just medicine. I would think of it more like health, but health can be science, too. Like so many things can be science." Each of these examples along with others offered evidence of the girls' evolving definitions of science across the two weeks. The definitions offered by the girls were different from one another, but they were present and as a part of my first layer of analysis I wanted to capture them for further review.

During the second layer of analysis, the narrative analysis, I reorganized the data and reviewed each girl's data set separately, looking for specific patterns and outliers in their data. In Chloe's data, the metaphor of a dog and a breeder emerged as extremely important as I sought to better understand how she personally defined science and how that definition evolved over time. During one of our program discussions Chloe said,

> It's kind of like saying that if you get a dog from a breeder and then the dog starts acting out because it's been with you for so long and you didn't train it. It's kind of like blaming the breeder for why your dog is acting out, but it's really because it's your fault… I feel

like because there's people doing science, it's no way for it not to be biased in some sort of way.

It was evident that Chloe was trying to account for bias and human subjectivity as she worked through her definition of science. I coded this and other comments like it in Chloe's data set as *people do science.* I also applied this code in other data sets that shared similar definitions of science.

In the last layer of analysis, I looked at Chloe's, Elaine's, and Jordan's data sets as specific to their expressions but as a collection of data that would guide my portrait creation. I sought overarching similarities and major differences to develop complementary portraits that could also stand on their own. I was especially curious to discover how the girls' expressions of Black girl imagination emerged in similar yet different ways. As I reviewed their data side-by-side, I noticed that all three focal participants grappled with the systemic nature of science. They spoke and wrote about science as a system and distinguished that from the acts of individuals. Hence, the code *systemic science* became a guiding code during layer three.

Within each layer of analysis, I traversed across layers as new ideas emerged and new questions about the codes and the data needed to be answered. In addition, as I navigated across the three layers, I also conducted visual discourse analysis of the data presented. One artistic expression that enhanced my understanding of the three science related codes was Elaine's graffiti as protest artistic expression shown in figure 5-8. In her artistic expression I noticed her use of color, the attention she gave to the word "NOT" in the image, and the contrast between the way "natural genetics" was written in comparison to "eugenics." The presence of the slime-like font used to write "eugenics" along with the prominent "NOT" signaled that Elaine disagreed with the scientific agenda of eugenics. Her disagreement bolstered her statements about

disagreeing with many of the choices scientists make that harm communities of color. I followed a similar process for all codes listed and the entire data set.

Portrait Construction

After conducting the layered analysis for my three focal participants, Chloe, Elaine, and Jordan, I returned to my three research questions to further organize the narrative portraits presented in Chapter 5. My three research questions are:

1. How do adolescent Black girls express their *Black girl imaginations* when participating in a critical, informal science learning space designed with them in mind?
2. What do their expressions of *Black girl imagination* reveal about their articulations of self?
3. What do their expressions of *Black girl imagination* reveal about their meaning making in science?

I sifted through the codes I developed during the third layer of analysis to identify the ways that each girl exhibited childhoodness, creativity, and criticality. Within each of these large categories, I was able to learn how Chloe, Elaine, and Jordan described themselves, how they defined science, how they were grappling with the context of 2020, and how they experienced Black girlhood. I sought to reveal the unique complexities of Chloe, Elaine, and Jordan by sharing key stories, discussion contributions, and my interpretations of them. I organized quotes and artistic expressions based on their relevance to the three research questions and elevated the ones that most reflected the girls' participation in the program and presentations of self. In table 4-4, I summarize one unique complexity about Chloe, Elaine, and Jordan with respect to the key categories that guided my construction of each portrait. The complexities highlighted in table 4-4

are included in the portraits offered in Chapter 5 along with others to support the reader in gaining a well-rounded image of each focal participant.

Table 4-4

Chloe, Elaine, and Jordan Complexities

	Self-Descriptions	Defining Science	Grappling with 2020	Black Girlhood Experiences
Chloe	"I think I'm artistic, obviously, because my favorite hobbies are doing drawing on my iPad and maybe painting. It's like something I'm very passionate about. I think I'm honest because sometimes, it's not always the best thing, because I'm sometimes too honest and then it hurts people's feelings. But I don't mean it. It's something that I want to work on, you know?" (interview)	"I feel like it just depends on what it is because I feel like there's a lot of things that science has said that's kind of a little prejudice towards a certain group of people that they haven't really cleared up...I was reading something about how they try to make it, when it comes to certain races, how they try make it sound demeaning... I feel like because there's people doing science, it's no way for it not to be biased in some sort of way." (daily session)	N/A	"I feel like it [being a Black girl in society today] means, it can mean a lot of things, but I feel like it means to basically, just embrace yourself as a black girl, slash as a black woman and just stand up for who you are. Since we're women and we're black, it's kind of like, in society, a double negative." (interview)
Elaine	"Also, Elaine kept saying she's quiet, she's quiet but she would be the first one to join the conversation and, you know, open up dialogue about a question so, that was interesting. A lot of these girls in their three words	"Um, the way I see it is like if you have a person who let's say they have a pencil and they use that pencil to hurt somebody else. Well, like that's on them. Like, it's not really the pencil's fault, like they are the one that used the	"For me, it's kind of been overwhelming like at first when we got home, I was kind of happy because I mean we get to chill and be at home and not be at school, um, but like, over time, like it's just	"Like I said before, we're young, we're girls, we're black, all of the that. The world can definitely use and better from because, like, we don't have a lot of young black girl voices out there. And so, I feel like just knowing the

	they also said a lot of positive things. They spoke about themselves in positive ways." (impressionistic records)	pencil in the bad way and when the pencil can be used for other good things like writing and stuff. That's just how I see it." (daily session)	got more and more, I guess, serious and things that hit close to home, like the whole Black Lives Matter thing. (pauses) And I've cried and that's okay. Yeah." (focus group)	potential that you have and how valuable your voice is and can be, is pretty great." (interview)
Jordan	"I like…My favorite part [about being me] is how, I'd say, how considerate I am, I guess. Like so, for Christmas, Mother's Day, Father's Day, stuff like that…Well, Christmas, specifically, I don't really think about presents I'm getting, like I'm receiving. I really put a lot of thought into the gifts I give. Even though they might not be the most expensive because I don't have a job." (interview)	"I think that, at least for the Aboriginal medicine one, religion and spirituality definitely had to do with [science]... I know that the different cultures are really dependent on their spirituality and then they're different doctors for the medicine and actual spiritual doctor about like kind of, I guess you could say they knew what to try and they just didn't know how to…" (daily session)	"Early in June, we set up a vigil for…it was mainly for George Floyd, but it was for everyone who died unjustly by the hands of police officers. We made a whole bunch of signs. We had a whole bunch of speeches saying like, this is not okay. We had a bunch of discussions saying why it wasn't okay." (interview)	"sad part of a teenage girl's life, all the upsetting parts of an actual teen Black girl's life, just because I am a teenage Black girl. So, it says, 'Do better, work harder." It does have a racial slur because I've been called it before. It felt like a key part of my life, so I felt to put it in there." (video diary)

In addition, I sought to include narrative descriptions of my interactions with and perceptions of each girl throughout our two weeks together. For example, I provide a detailed description of what it was like to meet Chloe's mother and to drop off her art kit to her home. I also add in quotes from my impressionistic records to share my perception of the girls. My voice

as portraitist is present in efforts to offer well-rounded, nuanced images of Chloe, Elaine, and Jordan. I present three visual and narrative portraits in Chapter 5.

Chapter 5
Portraits

In this chapter, I present narrative portraits of three adolescent Black girls—Chloe, Elaine, and Jordan—who participated in Empowering Girls Through Art & Science. As the portraitist, I sculpted each narrative portrait from my perspective after engaging with the girls for two weeks (totaling 20 and a half hours). These portraits are meant to capture how the girls presented themselves and expressed their Black girl imaginations in my limited time with them. These portraits offer beautifully nuanced, yet bounded, literary images of each girl as they participated in a critical informal science learning program.

While constructing each portrait, I stayed close to the data provided, consistently rewatching and rereading their words, body language, and artistic expressions. The portraits included in this chapter are intentionally written in my narrative voice to create a literary environment that closely resembles the one experienced by participants and me. Accompanying each written portrait is a visual representation of each girl that is meant to reflect what words on a page struggle to reveal. I include the visual portraits to enhance the narrative portraits to convey their varied expressions of Black girl imagination more fully.

Before offering the collection of portraits, I set the physical and emotional context of the city where Chloe, Elaine, Jordan, and I live, as well as that of the first day of Empowering Girls Through Art & Science. My intent is to open the door for those who were not physically present to join the space from my perspective as researcher, program facilitator, and portraitist (Lawrence-Lightfoot & Davis, 1997). I then offer the three visual and narrative portraits

constructed to provide an overall representation of each girl, attending to my three research questions:

1. How do adolescent Black girls express their Black girl imaginations when participating in a critical informal science learning space designed with them in mind?
2. What do their expressions of Black girl imagination reveal about their articulations of self?
3. What do their expressions of Black girl imagination reveal about their meaning making of science?

Weaved within each narrative portrait is a reflection of how I perceive my conceptual framework being evident in Chloe's, Elaine's, and Jordan's participation in the program. In Chapter 6, I unpack the three portraits and discuss the significance of my findings in efforts to guide science educators to center Black girls and their Black girl imaginations in the development and implementation of science learning spaces.

What Up Doe?!

When native Detroiters think of Detroit, their chests usually swell with pride for the city they love so dearly. Whether it's the soul greeting of "What up doe," the one Coney diner that serves the best chili cheese fries, or the fond memories of "growing up near Schoolcraft," Black Detroiters have a love for their city that is alive and well. I am not a native Detroiter. I have only lived, attended church, volunteered, and enjoyed life in Detroit for almost three years, but as an outsider within, I have felt the admiration and deep connection Detroiters have for their city. Detroit currently has a total population of over 700,000 residents with over 80% of them identifying as Black or African American (U.S. Census Bureau, 2019). The overwhelmingly Black population in Detroit is a legacy of The Great Migration, a period in history spanning 1916

to 1970 during which more than six million Black men, women, and children from the rural South relocated to cities in the North, Midwest, and West in hopes of escaping Jim Crow.

The height of the industrial era enticed Black people to flee the dismal economic restrictions and the harm and death inflicted upon them by racist whites in the South. They moved North in search of economic freedom and racial equality (Wilkerson, 2010). Of the various cities Black people chose as destinations when migrating away from the South, Detroit's historical significance stands out. Its electric environment has fueled and inspired Black creativity and nurtured the evolution of Blackness for decades. Detroit has been highly regarded as a thriving Midwestern hub of Black culture, Black life, and Black music as the birthplace of Motown music. The soul that once echoed through the homes and businesses of Detroit during the Motown Era continue to swirl throughout the city, recycling and reinvigorating Black resilience and Black joy.

The economic and cultural boom that percolated within Detroit during and after The Great Migration was drastically interrupted as it became one of the Black cities in the U.S (like Chicago and New Orleans) "identified as 'dying,' 'disasters,' and centers of 'urban decay' in need of outside rescuing…" (Wilson, 2015, p. 3). Throughout the late 20th century, the city that once housed a total population of about 1.9 million residents experienced a great exodus of white Detroiters, where they took their tax dollars to the suburbs. After a devastating economic downfall in the late 20th and early 21st centuries, even more residents fled in search of jobs and security outside the city. Detroit once relied heavily on the automotive industry, but with advancements in technology and relocation of factories, the demand for blue collar jobs rapidly decreased. Like The Great Migration, there was another large movement of Black people as Black Detroiters were forced to migrate to new cities where they could make a decent living to

provide for their families. This time, Black Detroiters were moving away from the beloved city, leaving many Black owned businesses vacant, homes abandoned, and classrooms empty with fewer and fewer left behind to fill the resulting void. Government officials did little to invest in the lives of the Black Detroiters who did remain, and, as a result, Detroit has and continues to experience the ramifications of extreme economic hardship, increased racial segregation, high poverty levels, and underperforming schools (Wilson, 2015).

Black families that stayed in Detroit and those who have since returned to the city are working to remain united despite the ongoing legacies of neglect and disinvestment. Black Detroiters have been spearheading the revitalization of their neighborhoods, learning about and educating one another on urban farming (Lewis, 2021), and enhancing the opportunities available for entrepreneurship (Roberts, 2021) and creativity (Randolph, 2021). At the same time, gentrification and other means to "revitalize" the city continue to multiply, with little to no anticipation of investing in the lives and well-being of Detroit's Black residents. These efforts to "revitalize" Detroit are being made in efforts to make the city more appealing to white people, creating a culture where those who are white and not native to the city are enticed to move in.

Despite it all, Detroit remains resilient. Its adaptability and perseverance are evident in its collective imagination—its ability to adapt and transform itself to meet the needs and aspirations of its people *now*, rather than simply seeking to return to what it once was. Black imagination deems Detroit worthy of revitalization not just because of its rich legacy of Blackness but because of what it can be in the future. Detroit's collective Black radical imagination motivates the belief in and demand for social, economic, and educational justice that benefit Black Detroiters today and those to come.

I present Detroit alongside this collection of portraits as a complement to Chloe, Elaine, and Jordan because it is necessary to understand that the context and environment in which these girls are experiencing adolescence is one of revitalization, resilience, and Black radical imagination. Detroit serves as a particularly fertile ground for Black girl imagination to be explored. The girls are surrounded by Black people imagining futures for themselves and their communities that look drastically different from their current realities. Examples of actualizing one's radical imagination are accessible to Chloe, Elaine, and Jordan because they are experiencing adolescence during such a pivotal time for Black liberation in Detroit.

This same resilience that fuels the life of Detroit, the same demand for change, was particularly palpable in the city during the summer of 2020, the summer of the program I designed and led, Empowering Girls Through Art & Science. Most streets were empty of cars and rush hour traffic had subsided due to the limitations resulting from COVID-19, but the streets in downtown Detroit were flooded with mostly masked protesters demanding justice for Ahmaud Arbery, Breonna Taylor, and George Floyd. Signs reading "No Justice. No Peace." and people chanting, "We have nothing to lose but our chains!" echoed among tall buildings in the center of the city. Black Detroiters, fueled by their own experiences of injustice, and their collective dreams of a different future, swarmed the streets. Detroit's historical footprint and contemporaneous resurgence are the landscape for which Chloe, Elaine, and Jordan showed up and participated in Empowering Girls Through Art & Science.

"Welcome to Empowering Girls Through Art & Science!"

As described in the previous chapter, Empowering Girls Through Art & Science was originally designed to be an in-person program. I imagined a space ripe with conversation, inside jokes and laughter, side conversations, and opportunities to get to know the girls while playing

games, eating lunch, and taking walks outside. Because of the unexpected effects of COVID-19, I reorganized and re-envisioned the program to take place virtually over a shorter period of time. With the reconceptualization of the program came a plethora of missed opportunities coupled with new and unexpected ones. I felt like the toolkit I had spent the last eight or so years curating for cultivating empowering learning environments was slightly ill-suited to the virtual learning space. I found myself at the crossroads of feeling like both a novice teacher once again and an ever-evolving scholar of the practice. This new identity created a vulnerability in me as a facilitator that I had not previously anticipated. Although uncomfortable and frustrating initially, my vulnerability served as an asset to help me share facilitation with the girls. As both a teacher and a researcher, the virtual space limited my own interpretations of Jordan, Elaine, and Chloe because their presence was limited to the small rectangular boxes on my computer screen. This hindered my ability to pick up on their energy and individual quirks. I was forced to rely on their personal descriptions of self, which enabled me to center their voices more thoroughly in the portraits presented in this chapter.

I felt my uncertainty about virtual facilitation from day one of the program. It was 9:51am on Monday, July 6, 2020. I sat in my white leather desk chair and pulled myself up to the all-white desk I had positioned in front of a window facing the quiet street in front of my Detroit home. An old picture of my grandmother and me in a broken pink floral frame sat next to my laptop and large second monitor. The blinds were pulled all the way up so an overflow of natural sunlight could enter the room and illuminate my golden melenated skin. “The sun rises in the east and sets in the west. Right, right,” I said out loud to the empty room. I realized my window was facing eastward because the direct sunlight I had anticipated was peeking from behind my

home instead of shining directly in front of me. *This would have to work.* I reassured myself that it would get brighter as the day went by.

Although the sun was physically shining on that day, a sense of gloom permeated the lives of many Black Americans. I, along with many in the Black community, were grieving yet again due to the senseless murder of innocent Black men and women. In just the past few months, the lives of Amaud Arbery, Breonna Taylor, George Floyd (and so many others whose stories had not gone viral on social media) had been snuffed out at the hands of police brutality and racial violence. Those deaths, incited by the mentality that whiteness owns the rights to control Black bodies and Black life, caused an eruption of protests, riots, and demands for equality by a people who had simply had enough.

I sat at my desk also at what was then the height of the global COVID-19 pandemic, which had swept around the world killing over 350,000 people in a matter of months (since then a total of 4.42 million have died). Within the U.S., COVID-19 was disproportionately affecting people who looked like me, with over 50% of the nearly 100,000 deaths in the U.S. (at the time) being Black people. The disproportionate effects of COVID-19 in the Black community were not by happenstance. It was and remains to be a manifestation of the legacy of systemic racism, resulting in a set of complex factors--the overwhelming presence of chronic underlying health conditions due to the lack of health care available to Black Americans, increased occupational vulnerability as Black people made up a large percentage of the essential worker population, and the limited access to personal protective equipment and COVID-19 testing centers in Black communities.

Between racially charged violence and the unexpected pandemic, Black mothers, Black fathers, Black teachers, Black bus drivers, Black coaches, Black pastors, Black people were dying.

As I wrestled with the overwhelming shadow of death and the persistence of racism, I sat at my desk preparing to welcome a group of rising 10th grade girls into a virtual Zoom room to talk about science. "Is this the right time? Who cares about science when so much is going on in the world?" So many questions of doubt flooded my mind. *This would have to work.* I took a few slow, deep breaths.

In.

Out.

In.

Out.

I felt like I was inhaling all things Black Girl Magic and exhaling the intense jitters I had running through my body. As I repeated this meditative breathing exercise, I uttered a brief prayer something like,

Lord, please give me the words to say. Allow the girls to enjoy this program. I pray it is meaningful for them and fun, too. I pray for their families during this crazy time. I pray these days bring them joy. Use me. In Jesus' name. Amen.

It was now 9:55am. I clicked the blue icon with the white camera in its center. Zoom. "Here we go!"

Guys you know you'd betta watch out.

Some girls, some girls are only about

that thing, that thing, that thing

that thing, that thing, that thing.

The second verse is dedicated to the men

more concerned with his rims and his Timbs than his women…

I sat with my video and mic turned on so that as the girls entered our virtual shared space, they could see me and hear the Lauryn Hill song, "Doo Wop," playing from my laptop. No one had entered just yet, so I was basically looking into a virtual mirror. I was looking at me, looking at me. At 10:00am exactly, I began to let the girls in from the virtual waiting room. The girls flooded into the room, many with cameras turned off. *This would have to work.* "Hello everyone. I'm excited to be here with you. Welcome to Empowering Girls Through Art & Science!"

Chloe

Figure 5-1

Inherently Light. *This is a visual representation of my interpretation of Chloe during our two-week program. Chloe possessed an illuminating aura of joy, creativity, and light that was impossible to overlook and even more so contagious to those around her. This image depicts her as majestic, a source of good, a source of light—in a way Black girls are rarely depicted in educational research.*

When I close my eyes and think of Chloe, I can hear her laughter. I imagine her telling jokes and laughing at them right away before anyone else gets a chance. I see bright colors and feel the warmth of light she brought to our program everyday she was there. Even when she came late, you felt a shift because of her presence entering the space. The weekend before the start of Empowering Girls Through Art & Science, my husband and I drove for a little over five hours around Southfield, Ypsilanti, and Detroit delivering art kits to girls participating in the program. There were so many homes on so many streets. To keep track of my visits I took notes to remember how I felt pulling into the girls' driveways, what it was like to meet them for the first time, and how they made me feel after briefly talking with them and their families. For many of the girls I must go back to my notes to jog my memory. For Chloe, I remember vividly.

Chloe's apartment building was hidden in the back of the apartment complex. Even when I was finally able to locate her building, her actual apartment door was tucked away and hard to find. As I pulled up to the parking lot, there was a young girl, about six or seven years old riding her bicycle in the street. I remember thinking, "Why is she riding her bike in the street? That's so dangerous! I could have hit her." My sudden slam on the brakes didn't cause her to flinch one bit. She just kept pedaling her two-wheeler past me, without even the slightest glance my way. Relieved, I parked in the first open spot I could find. I got out of the car, put on my mask, and had the bag of art supplies in one hand and my cell phone in the other. I thought I might need to text Chloe for further directions because the organization of the apartment complex was a tad bit more complicated than I was used to.

As I walked to the back of the complex, I noticed an apartment that had the most decorated front porch and flower bed I have honestly ever seen. It looked like a serious artist lived there. There were flowerpots on the porch, some hanging from the awning, others

bordering the sidewalk which led to the porch. Each pot appeared to be hand-painted, with brightly colored patterns and stripes in intricate designs. Some looked older than others because their colors were beginning to fade, but all of them were filled with beautiful flowers. Mostly yellow. There were garden statues, painted concrete slabs, and multicolored pinwheels strategically placed on the porch and in the flower bed surrounding it. A yellow, pink, and green rocking chair sat in the corner of the porch, perfectly placed to stare into the woods about 100 feet behind the building.

As I admired the colorful adornments of the front porch, I realized this was actually Chloe's house. I found it by accident! I walked up onto the porch and read the sign hanging on the door: "Black Lives Matter" in rainbow-colored letters. I smiled and knocked.

A woman came to the door and, as she unlocked it, I stepped back to the porch steps to maintain as much social distancing as possible. She answered the door with such a welcoming smile and spoke to me through the screen door,

> "Hi! You're here for Chloe? You just missed her. She said you would have something for her. I'm her mom. You can just leave it with me."

After I introduced myself, Chloe's mom shared how excited Chloe was to participate in the program.

"She just can't stop talking about this program. She loves to draw and loves all things artsy. So do I if you couldn't tell."

She chuckles and points to all her front porch garden art.

> "Just so you know, Chloe is a talk-ER! She's missed being in school and being with friends so I think this will be good for her. Thanks for stopping by! She'll see you on Monday."

I handed over the canvas bag of art supplies, shared a few laughs about the awkwardness of our new normal, and I walked back to my car. I didn't even meet Chloe that day, but after experiencing the front porch of her home and her mom's sweet yet strong demeanor, I felt like I knew so much about her. We pulled off as the little girl I almost hit on my way in waved at me and smiled.

"Hi, My Name is Chloe."

When I did finally meet Chloe on the first day of Empowering Girls Through Art & Science, I was reminded of the artistic, eclectic, and warm aura I received from the front porch of her home and the brief interaction I had with her mom. That same joy and light burst through the screen during the Run & Go Get It icebreaker when she said with a huge smile, "Hi, my name is Chloe!"

Chloe wore her hair in long dreadlocks with the front few locs dyed blonde. She wore large silver hoop earrings, which I noticed right away because they seemed to adorn her bubbly personality. When Chloe entered the Zoom room, I knew it. Partly, this was because she always entered the room without her microphone on mute, and I could hear her dog barking or her younger sibling crying in the background. I also knew she was in attendance because when she was there, she was always laughing and smiling, which accompanied each of her contributions to our group discussions. It was helpful for me because she gave me the feedback that I needed in our virtual learning space.

During the first week of the program, Chloe took some time to warm up and get acquainted with her peers and me. She attributed her limited verbal participation at the beginning of the program to being shy. But as the days went by, she became one of the most consistent

contributors in the group, making her articulations of the world around her fodder for our discussion. She became eager to share her art meditations and to offer her thoughts.

During the program, I did wonder what inspired Chloe to begin sharing more during whole group discussions, but because time moved so swiftly, I never thought too deeply about it until my one-on-one interview with Chloe after the program concluded. Chloe shared that she trusted me and the environment we had cultivated collectively. Chloe shared that she became more comfortable sharing her bold perspectives and personality with the group, which brought me great joy to know that the space I worked so diligently to develop was meaningful for her and was helping some girls feel visible.

When she began sharing with the whole group, Chloe sometimes got wrapped up in her own words to the point *she* wasn't even able to understand what she was trying to say. From my perspective, it felt like her mind was moving more swiftly than her mouth was. She would end those moments with something like, "I don't know if that makes sense to anyone, but yeah…" I loved that Chloe felt comfortable enough to work out her ideas in front of the group and that the space did not require her to present fully formed thoughts. All thoughts were productive and welcomed.

In Chloe's presentation of self, she added nuance to what I theorized positive visibility to look like and feel like for Black girls. In addition, to Black girls having the ability to be seen, investing in the visibility of Black girls is offering space for them to be vulnerable, work through emotions, and try ideas out. Seeking to disrupt the perpetual invisibility and hypervisibility of Black girlhood in science learning spaces means not expecting Black girls to show up as fully formed versions of themselves. That expectation does the opposite. It situates Black girls as invisible, devoid of opportunities to behave as actual children, naïve and evolving.

Chloe's Criticality

It was Day 9 of Empowering Girls Through Art & Science. We were in the midst of a discussion about racism and how it is ingrained in our country and consequently our legal system. Although the discussion was relevant to our lived realities, we had not arrived at this discussion on purpose. We were concluding the Who Done It? Is Science Guilty? learning task (see description of learning task in Chapter 4) and groups were presenting their cases for whether science was guilty of the harm caused to communities of color.

At this point in the discussion, the girls were comparing the fields of science to the legal system to inquire if science was to blame for harm or if individual scientists were the ones to be charged as guilty. I'm not sure if the girls made this connection or not, but it was clear to me that our discussion was centered on whether the pain inflicted in the Tuskegee Syphilis Experiment, the unethical treatment of Henrietta Lacks, eugenics, and the sterilization of Black women was a manifestation of systemic racism and disregard for Black life or if it was simply a result of individual acts of racism and discrimination. Most of the points the girls raised were in support of blaming individuals versus the fields of science, until the analogy of the legal system was offered, and Chloe shared her perspective:

> Well, what I was going to say was our whole country is built off of racial injustice and built to benefit white people. So, I feel like it's kind of, I don't know. I expect the legal system to be that way. Not because it's good! But because of the way that the government is built, the way history has gone. It's already bad, so is everything beneath it. If it gets better and the cops start getting charged for what they do, I feel like one by

one, it's going to start going away because they know they can't get away with it. But since it's kind of like, it's not giving them a proper punishment, they just feel like I can keep doing it. It's not going to happen to me. That's the problem.

She ended her statement with a smile and immediately returned to mute. The conversation then continued as if what Chloe had just said was not monumental.

Although the girls moved on, Chloe's statement stuck with me. She had shared such a wealth of information about how she understood the relationship among the structure of our country, our legal system, and the effects of history, whiteness, and racism. In such a brief statement, Chloe had elevated the racism Black people endure in our country at the hands of our legal system and the ways our nation's systems are set up to benefit those who are white. Expressed using her own words, she also recognized that our current systems (i.e., U.S. government) are legacies of whiteness as property operationalized in structures used to harm or exclude Black people.

So much was revealed about Chloe's Black girl imagination at that moment. Her statement revealed that the critical lens she operated from was informed by her understanding of the ways that systems influence individual behavior, and the only way for individual acts of racism and injustice to be rectified is if the systems that govern them begin to hold individuals accountable. This brief glimpse of Chloe's criticality on Day 9 was not the first time I noticed it, but I use this example to set the stage for how she consistently revealed her Black girl imagination, specifically her criticality during our two weeks together. This example illuminates how Chloe unpacked many of the topics discussed in our program. It appears she was letting us into thoughts she had already been wrestling with for some time. It was clear to me that Chloe entered our program with a concern for Black people and Black girls. Empowering Girls

Through Art & Science simply offered a space for her to share those thoughts, specifically in the context of science learning.

As Chloe shared profound ideas during small group and whole group discussions, she was always still her bubbly and joyful self. She made lots of funny faces when she spoke, as if the wide and narrow movements of her eyes and mouth helped her work through her ideas. These faces made her, me, and others in the group laugh. These were welcomed comedic moments, which were difficult to have because of the limitations of our virtual learning space.

Chloe maintained this complex intersection of joy and criticality during my one-on-one interview with her. She used the same criticality revealed in her articulation of our legal system to describe the specific ways that Black girls are marginalized in the U.S. After being asked, "What does it mean to be a Black girl in society today," Chloe tapped her fingertips on her cheek and took a brief pause to gather her thoughts.

She responded by explaining how Black girls and Black women are the recipients of multiple forms of oppression and discrimination, particularly because of their race and gender. She said, "Since we're women and we're Black, it's kind of like, in society, a double negative. Not really, though. It's kind of like we get booted to the back, because America is basically built off white men."

Chloe interpreted the intersectional oppression Black girls and women endure as "a double negative," experiencing both racism and sexism simultaneously because the U.S. has been constructed to benefit those who are white and male.

As the interview continued, Chloe's perspective of the plight of Black girls expanded beyond racial and gender discrimination. She also considered how skin complexion influences the lived experiences of Black girls. In the Black community, those who have a fairer

complexion and are therefore in closer visible proximity to whiteness experience more privilege than those who have darker skin complexions. Chloe attended to colorism, specifically within the Black community, as she discussed what she deemed the most challenging things for Black girls:

> Um, there's so many [challenges about being a Black girl] … it's more like the colorism stuff, actually, more than the racist stuff that gets on my nerves more. It's like even Black… some, not all Black men, but a lot of them just well, not a lot but you know what I'm saying, they're very colorist. They're like I only like light-skins and I'm just like, we're all Black at the end of the day. Why does it matter? I tend to go on rants about stuff like this, but how skin color and stuff dictates who people like over personality or the connection, actually. It really bothers me because I'm like, someone's skin color does not dictate how beautiful they are, physically or personality wise. I hate how that's the way… there's a video of this dude who was bashing dark-skinned women and, in the video, they were so beautiful. I was like come on man! It's more of like the self-hatred sometimes in the community is most of the stuff that gets on my nerves. If we don't kind of get over the colorist stuff, then we can't really get over or help racism kind of go away because we got like internal stuff.

According to Chloe, not only are Black girls forced to overcome intersectional oppression due to racism and sexism, but they are also navigating colorism inside and outside of the Black community.

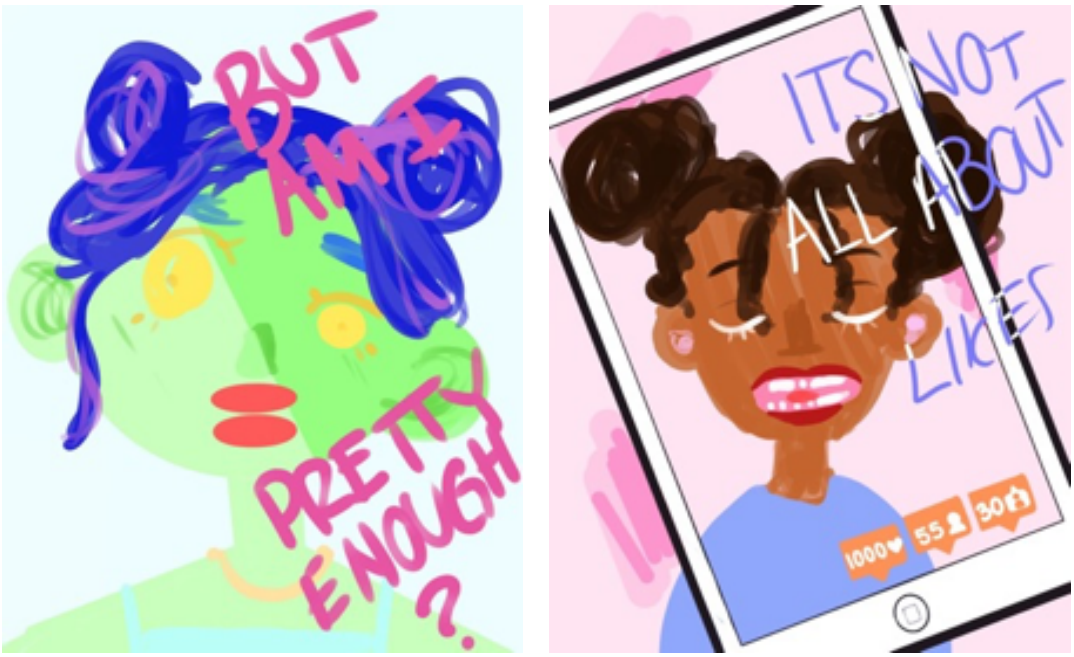
Chloe offered a nuanced way to conceptualize Black girls' intersectional experiences. Beyond race, gender, class, age, etc., Black girls (and women) also exist within spaces that assign and deny privileges based on skin color. Whiteness as property clarifies that the

overwhelming expectations of beauty are based on white women's standards of beaty. The closer one's skin color is to whiteness, the more privileges they receive. One of those privileges is the ability to be considered stereotypically (and narrow-mindedly) "pretty."

In her Jean Michel Basquiat inspired artistic expressions (figure 5-2), Chloe visually represented the wrestling girls endure surrounding beauty. The first image she created was of a Black girl who was inquiring if she was pretty enough now that she had removed her human skin, replacing it with green, alien-like skin. To me, the image posed the question, what does it take for a Black girl to be deemed beautiful by others in society? Does it require being extraterrestrial, more than human or maybe less than human to fit into society's ever-changing standards of beauty? Chloe's visual articulation of Black girls' experiences with skin color revealed in her first Basquiat inspired illustration presented how Chloe not only used her critical lens to investigate white America and Black girls' experiences within it, but to unpack Black girls' experiences within their own community, which can also be harmful and alienating.

Figure 5-2

Chloe's Basquiat Inspired Illustrations



Chloe's criticality of the world around her was coupled with her ability to see, dream, and envision life for Black girls, for herself, despite the challenges her criticality revealed. I was able to experience her Black girl imagination flourishing as she shared that despite the double negatives, "get[ting] booted to the back," and "the colorism stuff," Black girls should embrace and stand up for themselves.

"I feel like [being a Black girl in society today] means, it can mean a lot of things, but I feel like it means to basically just embrace yourself as a Black girl, slash as a Black woman and just stand up for who you are," she told me with a tone of empowerment in her voice and in her words. It seemed to me that her passion was fueled by her love of being a Black girl herself. She elaborated, "Well, since [being a Black girl is] the only thing I've ever known, it kind of just makes me… it depends sometimes, most of the time, all the time… I'm glad! I never regret the way my skin is or where I come from…"

Chloe's ability to see the problems Black girls face while also seeing the role Black girls play in their own liberation was evident during her two weeks in Empowering Girls Through Art & Science. In her second Jean Michel Basquiat inspired artistic expression (figure 5-2) she explored the ways her positionality as a Black girl during the social media era included the intersections of race, gender, and acceptance online. She boldly shared that "It's not all about likes." In other words, embracing yourself as a Black girl online means not being fueled solely by others' approval.

Chloe's Conceptualization of Time

Chloe's Black girl imagination was also illuminated in the ways that she articulated her conceptualization of time. She expressed time as a function of the past, present, and future being interwoven and dependent upon one another. Through the stories and hopes she shared, individual people have the ability to act as bridges between different eras of time, offering mentorship, guidance, and wisdom to those who are traversing life in the next generations. She attended to the relationships among past, present, and future through the value she placed on generational connection, particularly familial connections. Choe spoke frequently about her mom and the influence her mom has had on the Black girl she was at the time and the Black woman she hoped to be in the future. Her mother's influence helped Chloe become someone who was bold and confident in her own opinions and someone who felt free to express herself no matter how unique her perspective was.

When I asked Chloe what inspired her the most, she responded:

> Um, I think a lot of things inspire me, like I can't only say one because of the different times. But I think the biggest inspiration, don't tell her I said this, but my mom. She's so annoying *[laughs]*. She's kind of a big influence because she's very supportive of

> everything of all my family, and then she'll make sure to check you and stuff too. And then she also lets me express my opinion to her. Because I know a lot of parents… and when she's talking about how when she was younger, they would just shut her down and wouldn't let her talk. I just appreciate the fact that I can express my feelings to her, and she won't shut me down and she'll listen to me and tell me why I was wrong or something like that. And just like the way she's very comfortable being herself. That's something I want to be just in general.

Chloe's mom served as her role model because she was comfortable in her own skin. The space that her mom cultivated for open lines of communication and expression were meaningful to Chloe's evolution as a young Black girl and illustrated the connections Chloe makes between past and present. Chloe's mom's experiences of being "shut down" as a young Black girl informed the ways she chose to parent Chloe, and consequently the Black girl childhood that Chloe has been able to experience. According to Chloe, her mom has intentionally cultivated a mother-child relationship in efforts to offer Chloe a more liberated childhood than the one she experienced.

Chloe also spoke positively about the effects of time on generational liberation. She said, "I think the best part [of being a Black girl] is just getting to experience stuff that people back in the day probably wouldn't and be able to grow as a Black woman or a Black girl." According to Chloe, as time has gone by, the experiences that Black girls and women are afforded have improved, being able to take advantage of some opportunities in her childhood that were previously denied to Black girls of the past. Chloe illuminated the importance of theorizing with and for Black girls instead of using theories used to describe Black women's experience to describe those of Black girls. Although Chloe's mom's experiences were critical in informing

how she raised Chloe, Chloe acknowledged the particularities associated with being a Black girl in that moment and how it informs her visions for the future.

Her conceptualization of the future was one of service and mentorship. She spoke of her role as a future mentor to Black girls. As a future Black woman, Chloe anticipated her role as being

> able to encourage Black girls that they can be whatever they want. Whatever people say whether it's racist people or misogynistic people, whatever they say doesn't really matter. At the end of the day, them saying stuff is not going to change the way you look. You're still going to be Black. Your DNA is still going to be Black. So, you might as well embrace it.

Here, Chloe explicitly imagined her future self taking up the responsibility of reminding other Black girls of who they are and helping them to embrace their full selves the way she had been inspired to embrace herself fully. She imagined herself cultivating spaces of positive visibility for Black girls in the future.

Chloe's Articulation of Self

From the moment I first saw Chloe's home, with its painted flowerpots and multicolored pinwheels out front, it seemed like she came from a rather artistic family. Later, when asked to describe herself in three words Chloe, considered herself to be artistic, funny, and honest. She said that her favorite hobbies were drawing on her iPad and painting. She described these hobbies as things she was "very passionate about." She enjoyed creating art so much that she was interested in pursuing a career in art, possibly as "an animator or something like that." She characterized her love of art as an attribute she felt was passed down from her mother to her.

She elaborated on her love for art during our interview:

So ever since I was young, I've always liked to draw. It's been like a big… and my mom is pretty artistic. So, it's kind of, I grew up on it, basically. And so, the older I got, the more I liked watching cartoons and it kind of influences the way I draw. So, I feel like, it's like if I want to animate… just because I have so many stories in my head. I feel like I don't want them to go to waste.

Chloe's unique artistic expressions throughout the two weeks of the program further revealed her love of art. As she described each piece in her video diaries, she exuded so much passion for the work she created. In addition, her artistic expressions highlighted many parts of her personality that were briefly revealed during our daily sessions. One quality highlighted was her boldness.

Chloe's boldness was evident throughout her participation during Empowering Girls Through Art & Science, especially in her artistic choices. She created with vibrant, bright colors. Each of her pieces seemed unapologetic and made a bold statement that stemmed from her personal criticality of the world as an adolescent Black girl.

One of her artistic expressions comes to mind. Her execution of the graffiti as a protest expression (figure 5-3) was simple but it burst off the page. Chloe wrote "Women of Color Matter " in large neon green and yellow font, each of the letters with an ombre effect standing in contrast to the powder blue background. The color choice, font size, and it being located in the center of the page made a statement, but I thought the most interesting aspect of Chloe's message was that she chose to write, "Women of Color Matter" and not Black Women Matter. After initially viewing Chloe's piece, I wrote

I find it interesting that she chose to say Women of Color matter and not Black girls or Black women matter. Chloe has made it clear that she identifies as a Black girl, but she

also makes it known that she comes from a diverse family. I think Chloe wants to be inclusive here and recognizes that all women of color face some sort of discrimination and othering and she is inclusive of all women of color in this art protest piece.

Figure 5-3

Chloe's Graffiti as Protest

This image illuminated Chloe's commitment to inclusivity and acknowledging the lived experiences of all women of color.

Chloe also spoke about her boldness during my one-one-one interview with her. I realized that her boldness materialized in her habit of being honest with those around her. According to Chloe, she was "... sometimes brutally honest…" In reflection, she thought that this manifestation of her boldness was "not always the best thing, because I'm sometimes too honest then it hurts people's feelings. But I don't mean it. It's something that I want to work on, you know?"

For her self-portrait in figure 5-4, Chloe created a life-like digital version of herself. Based on my view of Chloe, it was a realistic representation of her utilizing a cartoon aesthetic. She drew herself wearing short shorts, a hoodie, and silver hoop earrings. She also captured her long locs and the blonde coloring that she has on a few locs in the front of her hair in real life. She presented herself with a slight smile holding up the peace sign.

Figure 5-4

Chloe's Self Portrait

She was intentional to include her curves in the image, drawing herself from the thighs up in a chill, informal pose. Her self-portrait projected confidence. It signaled to me a sense of boldness and strength. The color choices and her expression signal happiness and joy. Her representation of her body was a powerful artistic statement, signaling her confidence in her own body perception.

The self-portrait was a fitting representation of the Chloe I experienced in the program daily. As I engaged with Chloe throughout those two weeks, I hoped that her passion and

confidence would follow her into womanhood and continue to push her to be authentic and expressive, bold, and critical.

Chloe's Meaning-making of Science

Chloe's ability to be critical of the world around her in ways that helped her identify how Black girls and women have been unjustly treated in the United States fueled her meaning-making of science. The two weeks we spent together in Empowering Girls Through Art & Science were centered on exploring the ways Black people and Indigenous people have contributed to the histories of science and the ways those same people have been harmed because of scientific exploration and exploitation. Chloe held a very specific stance on the role science has played in the perpetuation of racism and sexism. Chloe's stance was consistent but evolved and became more complex the deeper we explored the science topics.

There were many conversations that stood out to me as I remember Chloe's perspectives about science. The first conversation took place during the infamous dialogue about whether science was guilty of the harm caused to communities of color. This conversation spanned across three days of the program because of the rich discussion and my desire to allow space for the girls to share their thinking and for their thinking to have space to evolve. I decided to jump start the conversation of the second day of discussing the topic by reminding the girls of the notes I took from the previous day's dialogue.

> You all have been saying that science is innocent. A piece that I wrote down that you said Chloe, 'using something that science created to do harm to communities.' So, you were saying these people [the scientists] were using something science created. So, if science created it, why isn't science guilty?"

If I had the superpower to see into their brains, I am confident I would have seen gears turning or light bulbs flickering because their facial expressions alone signaled that this question had them in deep contemplation. My question came from a genuine place. I was curious. How were they able to rectify within themselves that the tools, protocols, and processes created were used to do harm, but the source was in no way responsible?

Because I reference Chloe's contribution the day before, she responded:

> Yeah. It's kind of like saying that if you get a dog from a breeder and then the dog starts acting out because it's been with you for so long and you didn't train it. It's kind of like blaming the breeder for why your dog is acting out, but it's really because it's your fault.

Chloe had shared her understanding of systemic racism in our legal system the day before and on this day, Day 10, she used the metaphor of a dog and a breeder to describe the role of subjectivity in the "doing science." By using the dog and breeder metaphor, Chloe was elevating the role that one's own bias, discrimination, and racism towards others contributes to how they operate in the world.

Although Chloe did not use the word subjectivity exactly, she did say, "I feel like because there's people doing science, it's no way for it not to be biased in some sort of way." Chloe articulated that science is a human endeavor, meaning that it is innately flawed, possessing the potential to harm others if not contained, always existing with the ability to harm. To Chloe, science wasn't guilty and in my understanding of Chloe's thoughts, it was not fully innocent either. Science was science and depending on who was exploring the world or implementing the practices of science in communities, determined how it was used.

Chloe was intentional about her perspective that science takes on the goals, desires, and/or biases of each human being engaging in its practices. According to Chloe, in the specific

examples of the Tuskegee Syphilis Experiment, the story of Henrietta Lacks, the sterilization of Black women, and eugenics, the scientists involved were not utilizing the practices of science "for a scientific purpose. The scientists were acting out of racial prejudice." Purpose and intent were key determinants in Chloe's ability to place blame, not on science as a whole but on the individuals who were misusing it.

Chloe was type rope walking between claiming the fields of science to be subjective and objective. I was unsure of her actual claim. Did she think only individual scientists were guilty? Did she also deem science to be responsible because it was the enterprise in which scientists were apart of? Her comment that people do science, so there is no way for science to not be biased conflicted slightly with her dog and breeder example. Chloe was engaging in a productive wrestling between ideas. The limitations of our program only being two weeks and the limited opportunities in the curriculum for the girls to make connections, prevented Chloe from further grappling with these ideas and developing a formal claim. Although it was not where I envisioned the girls getting to in their thinking, it was better than I could image because they were thinking deeply and building arguments for themselves.

In addition to wrestling between the subjectivity and objectivity of science, Chloe's Black girl imagination was evident as she was attempting to make sense of the erasure of people of color in the histories of science. During our one-on-one interview, with disappointment in her voice, Chloe shared her thoughts about the monolithic representation of scientists and those who have contributed to science. She said passionately:

> They're trying to erase their existence, well not really, more like their validation. Same with like the pyramids...what I was thinking in my head, kind of, how people wanted to think the pyramids were made by aliens…

Chloe shared that the ways the fields of science are presented in modern day operate is by erasing the histories of people of color and denying them any validation that their histories and their explorations of the world have contributed to what we know today. I thought her example was so fitting. She described the "assigning of credit" for the creation of the pyramids to aliens as one example of the erasure of history and validation for accomplishments made by people of color.

Chloe's perspective of science kept evolving during our time together. The more ideas presented to her, the more her ideas were complicated. Her criticality was prominent as she made connections between racial unrest that were being experienced at the time and the science topics. Toward the end of my interview with Chloe I asked her,

> Would you say that [your thoughts about science are] different or similar to how you thought about science before our program? Would you have given the same answer if I asked you this before our program?

She responded, "I feel like I would have gave a similar answer, but probably less confusing." We both laughed. "Why?" I asked.

> Because it feels like this program opened more ideas of what science is...I never really thought that medicine would be considered a science. I would just think like, oh yes, it's just medicine. I would think of it more like health, but health can be science, too. Like so many things can be science. I don't know what my answer would be, but I know it would be less complicated.

In that moment I felt my mission had been accomplished. At least one girl was now a skeptic of the disciplines of science and was able to see that her Black girl imagination, her criticality, creativity, and childhoodness, were welcomed and necessary to thinking deeply about

science. Although I only had ten days with Chloe, my hope is that she felt empowered to boldly take her Black girl imagination into other science learning environments, asking similar questions, and requiring those who teach her to attend to similar ideas.

Elaine

Figure 5-5

A Self-sourced Serenity. *This is a visual representation of my interpretation of Elaine during our two-week program. Elaine exuded a serenity that was consistent despite circumstance. The tornado represents the challenges that Elaine describes as components of the Black girl experience. Even with the looming possibility of failure or the unfair expectations, Elaine's internal source kept her in a positive serene place.*

Elaine brought a sense of serenity to Empowering Girls Through Art & Science. The tone of her voice echoed waves of peace into every discussion she joined. I initially perceived her tranquil nature as an indication of uneasiness or maybe shyness, but I eventually learned that it was Elaine's demeanor, or at least how she chose to present herself throughout our time together.

As I got to know her, I soon learned that her sense of serenity existed simultaneously with her recognition of the insecurity, uncertainty, and fear of the future involved with being a Black girl. She described the presence of insecurity, uncertainty, fear of the future as hovering in the distance. She acknowledged its existence but was not moved by the possibility of its presence. It seemed that her external presentation of peace was a manifestation of an inner confidence. When she spoke, it seemed to come from a wealth of wisdom and tenacity that lived within her. I felt there were many times in the program where she drew from that internal source of strength.

Elaine exuded this sort of presence from the first day I met her, which was the day I delivered her art kit to her home. After knocking briefly on her door, Elaine answered and greeted me with a very calming, "Hi." She kept the screen door closed and stood with both of her hands straight down by her sides, seemingly waiting for me to say or do something to move our interaction forward. She wore a blue facemask, so I could hardly make out her facial expression at the time, but from the look of her eyes and eyebrows she seemed to be smiling.

I responded "I'm Mrs. Amber. Nice to meet you, Elaine. Are you ready for the program on Monday?"

Elaine responded quickly, still in a quiet tone, "Yes, I'm ready."

As I attempted to ask her a few more questions to get to know her, her dog began to bark hysterically in the background. It sounded like a large dog, which caught me by surprise and

startled me. It was impossible for me to confirm if the dog was as large as I had imagined in my mind, but it sounded huge based on the sound of its bark. I never actually saw the dog, but I found the dog's animation and extreme expressiveness quite interesting. It stood out to me because in contrast to Elaine's calm energy at the door, the dog seemed to have a completely opposite disposition. The dog's vocal presence amplified Elaine's serenity to me in that moment.

After my physical jolt from being a bit startled, Elaine chuckled audibly and apologized for her dog. We shared a short laugh. She opened the screen door to grab the art kit from me.

"Thank you!" she said quickly as she seemed to hurry away to calm her dog. "See you Monday!"

I waved and began walking back toward my car. "What if that dog came running out...whew thank goodness!" I thought to myself as I walked back to my car.

"I've Cried and That's Okay."

When Elaine joined our Zoom calls she joined from a well-lit corner of a room in her home. I'm not sure which room because I only had access to the two white walls that met directly behind her and the gold doorknob right above her head. Her backdrop led me to imagine that she was joining our calls while sitting on the floor. She sat in the same spot, with the same doorknob, the same ponytail containing her fluffy black hair which cascaded down her back, and the same smile every day we met.

Toward the end of Day 1 in the PM Group of Empowering Girls Through Art & Science I was facilitating a focus group with girls who were interested in participating in my research study. Those who were not interested had exited the Zoom call, and the 11 girls interested in participating remained. We were all still getting to know one another, and the figurative ice had

not been broken yet. As much as I wanted to ask the girls all the questions I had planned, I could not ignore the state of the world that existed outside of all our computer screens. I could not ignore the possible influence the world was having on each girl's emotional, mental, and physical wellbeing.

Instead of asking my planned first question, I began the focus group by asking, "How has it been living in the world today with all that's going on? How have you been feeling about all that's happening in the world?"

After a few seconds of silence, Elaine responded:

> For me, it's kind of been overwhelming. Like at first when we got home, I was kind of happy because I mean we get to chill and be at home and not be at school. But like, overtime, it's just got more and more, I guess, serious and things that hit close to home, like the whole Black Lives Matter thing (Elaine takes a significant pause), and I've cried and that's okay. Yeah.

In just those few sentences, Elaine opened the door for others in the group to share that they too had been struggling with the realities of COVID-19 and the racial unrest during the summer of 2020. A somber honesty filled the space as the other girls shared how they too felt emotional. They shared that they were missing friends, concerned about loved ones, and wondering about the future. Elaine's transparency ushered in an environment of positive visibility that welcomed vulnerability from others. This same vulnerability consistently emerged throughout the program as Elaine led by example, becoming an integral part of our group's discussions and learning.

Elaine's Understanding of Black Girl Childhoodness

Throughout the two weeks, it was clear that Elaine's vulnerability fueled her Black girl imagination. She shared candidly about the various struggles and challenges she faced as she experienced Black girl childhoodness and shared more broadly about some of the limitations and constraints Black girls her age are forced to overcome. Elaine's imagination was not simply evident in her acts of transparency around identifying obstacles. It was truly illuminated in her commitment to see, imagine, and push beyond limitations she identified. Throughout our time together, she coupled each challenge she presented with a vision for triumph or disruption.

During my one-on-one interview with Elaine, she shared with me the external pressures she felt were associated with the intersectional experiences of being young, Black, and female. In the same breath, she acknowledged that at the intersections of these identities existed the ability to decide not to conform or be contaminated by external pressures:

> There's a lot of things that we [Black girls] can contribute to [by] being a girl and being a Black girl and being a younger Black girl. I think there's a lot of things that we can learn about because of our intersectionality. But also, there's, I feel like there's a lot of pressure… It can come from everywhere. I don't know how to explain it, but just… it can come from like dealing with racism, sexism. It can come from dealing with school and the future and stuff like that. [The pressure] to be whatever they see you as, I guess, which may or may not be stereotypes and stuff like that. I know there's a lot out there and like, not everybody conforms to those stereotypes.

Elaine began by acknowledging the vastness of what a young Black girl can contribute to the world. According to her, the specific intersections of race, gender, and age that Black girls occupy allow for a wealth of diverse contributions. She explained that there is limitless nature to Black girlhood, but pressures and resulting stereotypes still loom in the distance. Stereotypes

that, as she further articulated, position young Black girls as "ghetto, or kind of like they don't care about things or whatever, they don't have dreams or whatever, and they're just always trying to keep up with trends." She identified these stereotypes and associated pressures as being produced by racism, sexism, school, and the unpredictability of the future. As she spoke, I remember feeling that the beauty in her words rested in her assertion that "Not everybody conforms to those stereotypes." Elaine clearly articulated that although the pressures and stereotypes exist, it is not mandatory for Black girls to adhere to them.

Elaine was fighting against the prevailing external denial of childhood that Black girls are forced to navigate. To draw from Audre Lorde (1984) writing included in Chapter 3, "a piece of the price we paid for learning survival was our childhood" (p.171). Elaine was refusing to pay the price Lorde references by not negotiating her childhood, which would have looked like her taking up the stereotypes and stresses that were offered to her. Protecting Black girl childhoodness is a responsibility of adults. Elaine extends that to also acknowledge how Black girls are protecting their own sanity as children by rejecting society's expectations. Again, to reference Audre Lorde (1984), "it is the right of children to able to play at living for a little while" (p. 171). Black girls can miss the opportunity to experience the liberty of childhood by waiting for adults to see value in preserving their childhoodness. Elaine has taken it into her own hands so that she can enjoy moments in the sun to simply "play at living for a little while."

Elaine's recognition of limitations and the acknowledgement of how Black girls can and do exist beyond them emerged again as she discussed the best part about being a Black girl in society today. She said:

> I think [the best part of being a Black girl is] the different points of view that we have. Like I said before, we're young, we're girls, we're Black, all of that. The world can

definitely use and [become] better from [our voices] because we don't have a lot of young Black girl voices out there. And so, I feel like just knowing the potential that you have and how valuable your voice is and can be, is pretty great.

Not only did Elaine identify that Black girls have a voice, but she also considered them uniquely valuable, with the ability to make the world better. Here, she acknowledged the invisibility of Black girl voice used to inform decisions in society, but she also spoke to the diversity of Black girl voices and the power they possess if centered and elevated. Just because young Black girls' voices are scarce, does not mean they are absent or that they do not hold significant ability to evoke change.

In our first personal art expression, the girls were tasked with creating at least two Basquiat inspired illustrations that captured how they felt about being a teenage Black girl in the world today. They were prompted to consider all their life experiences, friends, family, school, social media, self-esteem, etc. Elaine submitted two artistic expressions that were to be viewed as a pair (figure 5-6).

The first of the two pieces showcased one Black girl. The girl immediately caught my attention as she was in the center of the image, but just as prominent were eyeballs of various sizes that surrounded her, all seemingly to be watching her. The words "always watching," "I see you," and "don't mess up" lingered in the background offering further context to the presence of eyeballs in the image. It appeared Elaine was using her art to again acknowledge the threats to Black girl childhoodness and positive visibility by highlighting the external pressures, stereotypes, and specifically the surveillance of Black girls. Elaine was illuminating the hypervisibility and invisibility that Black girls must navigate in society.

Figure 5-6

Elaine's Basquiat Inspired Illustrations

On the contrary, her second image screamed community and the power that comes from Black girls coming together to support one another--the power Black girls have to make each other feel visible. Her second image centered two Black girls who were looking at one another and holding hands. Surrounding them were the positive phrases, "I feel your pain," "I'm here," "I got your back," and "I've felt the same." Elaine shared the power of Black girl visibility, particularly when it is nurtured by others who look like you and share similar experiences.

Together the two images illuminated the omnivisibility of Black girlhood, including the barriers, struggles, and challenges Elaine associated with Black girlhood along with what life *should* be like for Black girls beyond those challenges. As afrofuturist do, she used art to express the importance of community and relationships among Black people (Black girls in her case) existing in a world better than their reality. She illustrates that the eutopia afrofuturist represent in futuristic scenarios is possible in the midst of the midst of hypervisibility and invisibility. According to Elaine, you do not have to wait until the future for Black girls' visibility to be actualized. Black girls just need community.

In her video diary, Elaine offered her interpretation of two images:

> The first one represents being a teenage girl today because it's basically saying that most people feel like they're being watched and judged all the time. And the second one, the meaning behind this is that although we all probably feel like we're being watched and judged, we can come together and support each other since we've probably all felt the same way… it kind of plays into stereotypes and rules that girls have to follow. Yeah.

Throughout the two weeks, Elaine's vulnerability and transparency around vocalizing the struggles associated with Black girl childhoodness served as an opportunity for her to also elevate the agency of Black girls to protect *their own* childhood experiences. She never did attend to limitations without also attending to Black girls' ability to break through them and exist despite them.

Elaine's Articulations of Self

As I was reviewing the submitted self-portraits for our fourth personal art expression, I came across one that stood out to me because it so closely resembled the artist (figure 5-7). Yes, the visual representation of the girl in the image closely resembled the physical features of the girl in real life, but something more than that was evident as I stared at the image. A brown skin girl was centered on the page. She was captured in profile wearing a gray hoodie, with her dark brown hair pulled back into a ponytail. There was nothing flashy about her appearance.

Figure 5-7

Elaine's Self Portrait

What caught my attention about the image was how grounded, secure, and contemplative she seemed. Her facial expression, still. Her demeanor, serene. The background was slightly livelier than the expression on her face and in her body language. It was somewhat colorful, containing different shades of pink and purple bubbles and smudges. It was whimsical. For me it evoked joy, creativity, and childhoodness.

The portrait screamed Elaine well before I even knew she was the artist. This was because during our program I experienced Elaine as unbothered. She was steady. Not overly jovial, but not quite stoic either. She seemed approachable, kind, and thoughtful, but very intentional about how she interacted with others. She did not seem like the most extroverted girl in the room, but she was not the shy one either. She just seemed to have a handle on what she wanted to say and when she wanted to say it. When she spoke, she spoke confidently. She spoke

as if she was sure of herself, and, when she wasn't, she was transparent in saying, "I'm not really sure," or "Do you mind explaining what you mean by that?"

What she did not have an opportunity to share with her words, she shared through her art. Elaine expressed herself more fully during our daily art meditations and in her personal art expressions. Creating seemed to be the language she used to express a personality she didn't so readily make available to others during program discussions. In her art, she used lots of color, bold lines, and powerful words. She took risks and tried new things. When she spoke of her art, she smiled more. It seemed as if creating was her comfort zone.

The demeanor of the girl in the self-portrait was representative of the way Elaine presented daily in our program and even in my one-on-one interview with her. But the background revealed what I saw when Elaine spoke about her art, her love for creating, and her journey to becoming an animator for a cartoon series. Art seemed to be her passion. Her purpose.

In the video diary she submitted to accompany the self-portrait, she said:

> This is my self-portrait. I don't know if you can see it, but I used some pink and purple colors outside of here. I enjoyed making this art because I rarely do self-portraits. So, this one, this was a nice experience for me. This art represents who I am, because I want it to convey that although on the outside I may seem like bland or whatever, on the inside, which is kind of like the opposite of what I did... On the inside, actually, I'm not really bland. I can be like creative and imaginative, and I tried to convey that with all the colors and the shapes and stuff outside. I used some inking pen for the line art, some colored pencils for all of the coloring for the portrait, but some out here. And then I also used oil pastels and Posca pens for this outside.

In her reflection on the self-portrait she created, Elaine spoke about the image being an inside-out representation of who she was. She depicted what was going on within her, her true personality that few had access to, on the outside as the background. She took full advantage of the page's real estate, allowing for every inch of the space to be representative of her. Every inch occupied with conveying the duality of her persona; what others saw compared to who she knew herself to be.

Elaine had written about a similar dynamic when she described herself in her program application:

> To someone that is just meeting me for the first time, I would describe myself as more of a quiet introvert, yet imaginative, caring, open-minded, and sometimes intuitive. I would mention that, to some, I may seem "cold" or unsociable, but I truly welcome anyone who wishes to connect and communicate with me. I consider my personality strengths to be my imagination, respectfulness, my creativity, and my open-mindedness.

As in her video diary on the self-portrait, Elaine centered what others thought about her and used their perceptions to clarify who she really was. She used the words "cold" and "unsociable" in her application to describe others' perceptions of her. She was clear to call out that although those may have been opinions about her personality, they were not necessarily facts. They were incongruent with the ways she viewed herself. Instead, she saw herself as imaginative, respectful, creative, and open-minded.

Reading her application and reflecting on her self-portrait, I was left wondering, what *was* it like for others to interact with Elaine at school or in any other in-person environment? *Was* she cold? *Was* she unsociable? All I could really do was wonder because I had very limited access to seeing Elaine's interaction with others due to the constraints of a virtual learning

environment. The only in-person experience I had with her was a three-minute conversation the day I delivered her art kit to her home and that conversation seemed to be interrupted by me being startled by her dog. Although brief, that interaction was similar to the ones in the program where she presented as calm, cool, and collected.

Elaine was the expert on herself and her own lived experiences. So, when she said that she was, "creative, probably a thinker, and also very empathetic," I believed her. When she said, "I get pretty good grades and I like to stay on top of my schoolwork," I believed her. The only characteristic she ascribed to herself that I questioned was her description of herself as quiet. After the conclusion of one session, I said in my video recorded field notes, "Also, Elaine kept saying she's quiet, she's quiet, but she would be the first one to join the conversation and, you know, open up dialogue about a question so that was interesting." Elaine's presentation of self during Empowering Girls Through Art & Science did not lead me to believe that she was quiet, but because Elaine is the expert of herself, I believed her. I do believe that her typical presentation as quiet was an attribute she was able to stretch and challenge during our time together. The space cultivated for our program was not inviting for some of the girls, but for Elaine, it was a space she felt safe to be vulnerable and share her perspectives.

Elaine was nuanced and complex, and through a small window into her world, I was able to see how she grappled with others' interpretations of who she was and simultaneously exists beyond them. Elaine applied the same ability she had to acknowledge how Black girls are able to break through and exist beyond limitations placed on them to her perception of herself. Her vulnerability and transparency were apparent as she described herself and simply was herself throughout our two weeks together.

Elaine's Meaning Making of Science

We were in the heat of a discussion. Ideas were percolating. The girls were excited. Questions, answers, and postulations were being generated. "I'm curious because there's a distinction you all are making between the doing of science and science itself. And so, can anyone just explain why you all believe them to be separate versus hand in hand?" I offered this question to the group to hopefully lead us to a solidified definition of science. We had been having this conversation for about three days at that point, and there had not been a consensus reached among the group. Some believed science was an action, a process, something a person does. Others believed science was synonymous with nature. Water, air, and gravity were used as examples to define science. It was a debate between science as a verb and science as a noun. At one point Elaine made the argument that "science is all around us. It is in everything that we do."

In my mind, I thought for us to further explore the role science played in the Tuskegee Syphilis Experiment, the Henrietta Lacks story, eugenics, and the sterilization of Black women, we had to first collectively answer the question, what is science? It felt most productive to have a collective definition to work from for the girls to make an informed decision about whether science was guilty of the harms caused to communities of color. Elaine, resting in her very clear, very calm nature, responded to my initial question in a way I didn't expect, but was intrigued to unpack. She said:

> Um, the way I see it is, if you have a person who let's say they have a pencil, and they use that pencil to hurt somebody else. Well, like that's on them. Like, it's not really the pencil's fault. They are the ones that used the pencil in the bad way when the pencil can be used for other good things like writing and stuff. That's just how I see it.

Elaine was using a metaphor of a pencil to articulate how she was defining science. She was conceptualizing science as a tool, a benign tool, deployed by humans to either do good or to cause harm. I understood that Elaine was making the claim that science in and of itself was objective, neutral and that it only became subjective when it was operationalized by people. Elaine received a lot of head nods from peers, revealing why so many of the girls were convinced that science was not to be blamed for the harm inflicted in the four focal historical events. According to Elaine's thinking, science couldn't be to blame because she viewed science as an entity that existed without human influence, values, or bias. She was not alone in her thinking.

Originally, I was conflicted with the example Elaine offered, using the example of the pencil to describe how science is used by humans. On one hand, I agreed. Harding (1995) makes a similar argument by situating the doing of science as a result of how scientists interpret the natural world, incorporate their own interests, embed their values and biases. Similar to Elaine's explanation, scientists are to be held accountable because they are the ones who are "doing the science."

On the other hand, I was uncertain because I felt Elaine's explanation was incomplete. I did not feel like Elaine was attending to science to molded by the epistemological orientations of those who contribute to it. There was a disconnect between what scientists do and what science is, when in my interpretation, they are inextricably connected. "Science" as a formalized enterprise only exists when humans invest in it. Elaine's pencil metaphor turned out to be excellent fodder for discussion because it was moving us toward understanding science as a system similar to our legal system. It was, in the moment, in complete because she was only acknowledging the effects of the individuals not how individuals effect the system.

This specific conversation was somewhat uncomfortable to have because I was unsure of when to offer my point of view and when to simply let the girls grapple with the ideas on their own. Although extremely generative, thought-provoking, and surprising, the conversation was one I had barely had with my peers, let alone facilitated with a group of high school students. I felt unsure of when to interject. Typically, the question, what is science, isn't grappled with in formal science learning spaces. At most, teachers offer the definition of science or their specific disciplines at the beginning of the year and never revisit them again. It is typically taken as axiomatic that science is science and there's no point in defining it further. Empowering Girls Through Art & Science was different. We spent hours working together to form a definition and actually, never really reached a resolve.

As I struggled to facilitate this discussion and other discussions like it, Elaine remained steady. She was consistent in her perspective that science wasn't to blame for the harm caused. To Elaine, the scientists were to blame, because they were the ones who misused science. Her perception of the innocence of science remained stable throughout the two weeks. Although Elaine did not place blame on the disciplines of science, she was vocal about her disdain for the harm caused to the Black community due to eugenics. She expressed her disagreement of eugenics by using graffiti art to protest it.

Elaine used her creative voice to convey a powerful message. As I viewed the art created after our discussion, I was perplexed because her art did not speak to the scientists or the humans involved. In figure 5-8, Elaine used her art to depict eugenics as gross, using the imagery of green slime, not the humans who performed eugenics. Eugenics was drawn as something to stay away from. She contrasted natural genetics, which was drawn in different shades of brown, with eugenics. The arrows highlighted the "NOT" in the middle of the page also signaled eugenics as

something bad that she disapproved of. I also thought that the use of the green represented a rather stereotypical version of science, which Elaine thought would be recognizable by viewers of her art even if they did not know the definition of eugenics.

Figure 5-8

Elaine's Graffiti as Protest

Elaine's reflection of her graffiti art was:

This is my piece of art. It says natural genetics, not eugenics. And I enjoyed making this art because I got to play around with colors and stuff and do something that I haven't done before really, which is graffiti. And this art represents how I feel about the stories we talked about today, because it says natural genetics, not eugenics. And I feel like you shouldn't do eugenics. Eugenics is a bad thing and that you should just let people be naturally who they are genetically. And to protest means to basically speak out against something that is happening. And I'm using this as a form of protest because I'm speaking out against eugenics saying eugenics is bad, which is why I made it look sickly and gross. Rather, letting people just be natural is better. Yeah

Elaine's expression of her Black girl imagination revealed that she had a stable definition of science. Her definition closely resembled the ways that schools typically present science to

students. Her definition remained consistent over the two weeks, but something in her meaning making of science did shift and evolve during our time together. Elaine entered our program with an understanding that science is everywhere. As the two weeks continued, Elaine began to expand her understanding of when and where science takes place to include science taking place in the past. She also began to consider the relationship that science has had with Black (African) history and Indigenous history, culture, spirituality, and religion. She was grappling with the exploration of the natural world that generated in Indigenous communities globally centuries ago.

During our discussion following the Learning from the Past activity, I posed a question to the group:

> So, all of these have a cultural, religious, spiritual connection to them. Originally, everyone was saying, yes, they're all scientific and then now you're kind of exploring that they all have a cultural, spiritual, religious component to them, or their foundation is cultural, spiritual, or religious. I want to ask you a question. Do you feel like science and what you know about science allows for the bringing in of culture, religion, and spirituality? Is there space for that in science?

I heard a lot of nos and saw a lot of head shaking. Many of the girls did not believe science and culture, spirituality, or religion could co-exist. But Elaine spoke in opposition to most of the group.

> I think sometimes religion can be based on science. Since science is like always been existent, people may not have known about more scientific things that we do now, like in the past. And so, they may have made like religious and spiritual beliefs based on these scientific things, but they didn't like really know it was scientific.

In her response, Elaine positioned science as having always existed and that there was overlap between science and religion. Elaine did not give much credit to the people of the past for their discoveries and understandings of the world. She privileged the knowledge produced within Westernized science by saying religion can be based on science rather than science being based on religion. She positioned science as the influencer and not the influenced. Her expanded vision of science extended to her use of adinkra symbols in an art expression. After exploring the Learning from the Past activity, the girls were tasked with created a piece of art using adinkra symbols or inspired by Aboriginal dot painting to reflect on the science taking place during the creation of Egyptian pyramids, the process of Egyptian mummification, the creation of adinkra dye, and Aboriginal bush medicine.

Figure 5-9

Elaine's Adinkra Art

Elaine reflects on her art (figure 5-9):

Here is my piece that I made. I enjoyed making this art because it was very interesting learning about the different symbols in Adinkra and using them in a pattern. This

represents how I felt about the histories. Because this one, in this context, it means the divinity of Mother Earth. This one means resourcefulness and endurance. This one means adaptability. This one means creativity. And this one, these two mean the importance of learning from the past. And I used these since the Aboriginal people used lots of different medicines, bush medicines, in order to cure things. And to me, it was really creative and resourceful, and they were able to adapt by using their surroundings. And this has to do with the topics discussed today because of how the Aboriginal people used their surroundings to cure things like rashes and sicknesses and stuff like that.

Elaine's expression of her Black girl imagination was evident in her ability to identify limitations, barriers, and stereotypes as threats to childhoodness and in response, envision and exist beyond and despite them. This was evident in her description of what it means to be a Black girl in society today. It was also evident in her articulations of self, as she acknowledged what others thought of her, but was clear about the ways her true personality was in opposition to the limitations other placed on her. Elaine's ability to see beyond what others presented to her was lost in her ability to reconceptualize science. Her conceptualization of science was not inaccurate. It was just incomplete. The lack of connection between individuals acts of racism and how they inform a system that perpetuate racism was a result of the pedagogical decisions made. There were not learning opportunities or scaffolds to support that intellectual leap. In the opportunities provided, Elaine was able to acknowledge that humans make decisions, and those decisions have consequences and can harm others.

Elaine was able to expand her understanding of science to see it as an endeavor that existed in the past and was in some way in relationship with religion, culture, and spirituality. Elaine ended by offering the same incomplete definition of science—something that is without

human subjectivity. Focusing my analysis on Elaine's expression of her Black girl imagination illuminated the ways that her creativity fueled her ability to communicate, express her true personality, and grapple with ideas she may not have grappled with before. Her creativity provided a lens to further see the ways she was critical about the systems that influence Black girls' lived experiences.

Jordan

Figure 5-10

Is This Déjà Vu? *This is a visual representation of my interpretation of Jordan during our two-week program. Jordan described herself as a youth activist and took pride in her participation in her school's Black Student Union. Jordan situated herself as a key participant in progressing the movement for racial justice forward in the U.S. Her disappointment with time and the lack of progress made toward justice fueled her. She enlisted in a fight she did not start but saw herself playing a similar role as those who came before her.*

Jordan was committed to the fight for racial justice. She was thoughtful about her presence in the world being one of meaning. She was hopeful to contribute to the change she hoped to see in the world through learning and protest. Although my first impression of Jordan was established well before meeting her on the first day of Empowering Girls Through Art & Science, I did not know her passion for racial justice was so prominent in her life. What I was able to surmise about Jordan during her program application was the characteristics that promoted her passion and drive.

Each participant submitted a program application prior to the start of the program where they answered questions about themselves. Three of the questions in the program application asked possible participants to describe themselves, share their prior experiences with science, and explain why they were interested in joining the program. From this application, I got a glimpse of Jordan that was further confirmed during our two weeks together. After reading her program application, I left with a vision of Jordan that she was focused, goal-oriented, and resolute. I also noticed that she seemed caring and thoughtful of others.

Question nine of the program application asked, "What would you consider to be your strengths and what are some of your areas of growth?" Jordan responded by writing,

> ...my strengths are being able to cheer people up when necessary and being a person that people can talk to when they just need to rant. My strengths include being an overall smart person. One area of improvement that I have is that I'm a little impatient when it comes to school. If a teacher doesn't teach me how I want to be taught, I get a little frustrated.

Immediately I thought, "oh, she knows what she wants!" I found it interesting that she not only acknowledged her impatience as an area of growth, but that she used the example of

being impatient with teachers who do not teach in the ways most accessible and relevant to her. I could tell that Jordan took her schoolwork and future success seriously. I was not surprised by this because although Black girls are task with navigating being both invisible and hypervisible in schools, leading to limited exposure to advanced level courses, Jordan offers evidence that Black girls do care about their educational success and strive to do well in school even if they are systematically denied access to acceleration and intervention. I simply enjoyed reading how Jordan was intentional about her own future as a rising 10th grade girl.

Jordan's response to question ten of the application enhanced my initial impression that Jordan was traversing her Black girlhood with intention and purpose. Question ten asked participants, "Please honestly explain your previous experiences with science (in school and outside of school). What do you like most about science OR what is challenging about science?" Jordan responded,

> I really like science. Last year (9th grade), I decided to double up on science. I took intro to biology and intro to chemistry. This year, I'm taking physics and an epidemiology elective. I like the different types of experiments, but the main reason I like science is because when I get older, I want to be an anesthesiologist. I doubled up to get a head start on science because I knew that I'd need it.

Jordan was clear about her future career goals and decided to make conscious steps toward them. Whether or not these goals remained by the time she made it to high school graduation and beyond, in this moment, Jordan had a vision of where she wanted to be and could visualize herself achieving those goals. In her visualization of self as an anesthesiologist, Jordan was pushing back against the chronic invisibility of Black girls in STEM by demanding for her own positive visibility in not just one, but two science classes during her freshman and sophomore

years of high school. She was setting herself up to enroll in advanced courses later in her high school career and to be prepared for a pre-medicine degree in college, both spaces that are lacking representation of Black girls like Jordan.

Prior to meeting Jordan for the first time, I had no idea what she looked like, how she laughed, or any of her personal quirks. What I was able to preliminarily conclude, was that she pursued her life with purpose. I knew she was committed to her academic success and was intentional about working toward her career goals. I would soon find out that the same purpose-driven determination that she conveyed for herself in her program application transcended to her commitment to fighting for racial justice in our country.

More Than a Silhouette

On the first day of Empowering Girls Through Art & Science, I brought my initial impressions of Jordan with me. I do not know exactly what I expected, but I was excited to meet Jordan and learn more about her. I wondered if my first impressions of her were accurate. I was intrigued to know how her goal-oriented demeanor, which I assumed from her application, would be conveyed in my real time interactions with her. I was also curious to observe how her personality would intersect with the structure of our program and the science topics we would discuss.

When Jordan entered our Zoom room on Day 1, the room Jordan joined from was dimly lit. I was grateful that she had her camera turned on, because some of the girls did not, but to be honest, I was a little disappointed that I could not see Jordan well. The room was illuminated just enough to reveal the turquoise bedroom walls that remained Jordan's backdrop for the entire two weeks.

The camera was angled so that the ceiling light was behind her, presenting Jordan as a dark silhouette. Her silhouette showcased the two afro puffs placed beautifully on top of Jordan's head. Although I could clearly make out the outlines of her hair style, her other features were much more ambiguous due to the shadow created by her backlighting. I could not see her smile, the looks she made when she took pauses to think, or any other physical representations of emotions on her face.

Jordan required that I rely on the inflections in her voice, her emotional expressions through body movements, and her verbal contributions to decipher her presence in the program. I was not able to rely on seeing her facial expressions, which was initially difficult for me in a virtual learning space. During the first few days, facial expressions were my main source of interaction with the girls until they became more comfortable with talking during our whole group discussions. For ten days Jordan showed up to Empowering Girls Through Art & Science as a dark, back-lit silhouette. As time proceeded, I realized that I learned a great deal about Jordan although she presented as a dark silhouette. I became used to not being able to see her face and I relied on other expressions.

Being able to see students, feel their energy, make sense of their body language are key attributes of in-person teaching that I took for granted during my time as a high school science teacher. During Empowering Girls Through Art & Science, I was required to rely on more than just what I saw to get to know the girls, which was a terrific exercise for me. Children are more than what we perceive them to be. In this situation, it was critical that I paid attention to what Jordan said, how she said it, when she chose to speak, and what she was expressing even in moments where she did not use words. I had to also consult with her artistic expressions which proved to offer further detail on who Jordan expressed herself to be. Jordan and many other girls

in the program inspired great growth how I see and listen to young people, deliberately attending to the multiple channels in which they are communicating.

Jordan sometimes used her hands when she spoke to express her point. The movement of her head from side to side—nodding, or vigorously shaking—often revealed contemplation, agreement, or disappointment. Her laugh. Jordan did not laugh often, but when she did, I laughed too. It was contagious. She exuded joy as she spoke, even as she grappled with difficult ideas like racism. After getting to know her through the course of the program and our interview together, it seemed as though her hope for a liberated future for Black people fueled that joy, a joy that was even more palpable I believe because of her presence as a silhouette.

Jordan's Criticality and Her Expressions of Black Girl Childhoodness

It was about two weeks after the culmination of our program when Jordan agreed to sit down with me virtually for a 30-minute interview. Although the interview was intended to help me learn about Jordan's experiences in Empowering Girls Through Art & Science and her thoughts about science in general, it quickly became focused on her commitment to racial justice and the conviction she felt to participate in the change she hoped to see in the world. I was not surprised because Jordan was often making connections between the topics in our program with larger social issues happening in society.

About one-third of the way through the interview, we began discussing the history of science, particularly around the Tuskegee Syphilis Experiment and the sterilization of Black women, topics we had discussed in our program. I asked Jordan if she perceived any of these events of the past as having any connection to what was currently happening during the summer of 2020. This question sparked the conversation that would consume the remainder of the

interview; a conversation about race, racism, and the role that time has played (or has not played) in racial progress.

Jordan said:

> …back in the day or whatever, Malcolm X and Martin Luther King Jr, they were fighting for our rights. They were fighting for equality. They were fighting for us to all be equal on the same plane. Years later, in 2020, you'd think that since we were fighting for so many decades that we'd be equal. You'd think that we'd be there. We're not there, yet. We're nowhere near there. So, I feel like that's one big connection, the fact that we're still fighting for something that should be given to us, like that should be our God-given right, but it's not, unfortunately.

Our conversation about the ways that race, racism, and whiteness contaminate how science has been deployed in the Black community led to Jordan sharing how she was feeling about race relations in the U.S. as a whole. Jordan expressed frustration with the lack of progress that has been made toward racial equality. She was clear to acknowledge that it is not due to lack of work on behalf of Black Americans, but that Black people are being denied rights that should already belong to them.

In this moment and many other moments in our time together across the two weeks, Jordan expressed her Black girl imagination in the ways she wrestled with time. She began by wrestling with the relationship between past and present, which undergirded her disappointment about time not yielding evolution, not producing change. According to Jordan, there should have been a return on investment and that return should be the change she believes Black people are owed for the decades of fighting and advocating for equality.

As she spoke, Jordan used her hands to define what she meant by equality. She put one hand up in front of her face, as if she was chopping the air in half, and firmly said, "… Equality is right here!" She then put the other hand up underneath the first and said just as fiercely, "And we're right here! We want to be like equal, you know?"

Even as Jordan described how far we have not yet come; she was not hopeless. Her wrestling with the past and present was met with her dreams of what the future could be. It's a future she deemed worth fighting for, even at her age, 14-years-old.

Similar to Womack's (2013) description of time within afrofuturism, Jordan was articulating time as being hard to distinguish, with the past and present looking so similar that it was difficult for her to discern between the two. Her description of the future was reliant upon what she hoped we could move away from and move toward as Black people. As afrofuturist present artistically, Jordan articulated verbally a future where Black people were not limited by the past but were able to thrive for their own sakes and control their own destinies (Womack, 2013).

Jordan cared deeply about the plight of Black people, and throughout the program she referenced the hurt and harm Black people were currently experiencing in the height of the pandemic and the recent killings of unarmed Black people. Jordan specifically thought children, individuals her age, had a role to play in the movement for racial justice. She did not see the fight for racial justice as a task relegated only to the work of policy makers, government officials, teachers, parents, and adults. Young people were responsible, too.

Jordan acknowledged that being a child presented limitations to her abilities to fully participate in the movement for racial justice. Although there are other factors that she did not name, Jordan cited her lack of finances that prevented her from being able to contribute

financially to social organizations. Although she experienced financial limitations associated with being a child, Jordan was intentional about the role she played in the Black Lives Matter Movement:

> We can't really donate or anything because like, again, we don't have jobs. I feel like signing petitions, making sure we're educated, so as we grow up, we can also start educating other people on the Black Lives Matter Movement and everything. Yea, just staying educated—actually participating instead of just watching behind the scenes.

Jordan othered herself from adulthood in that moment, using financial accessibility (or the lack thereof) to situate herself as a child. She was clearly signaling a distinction between adulthood and childhood. To be clear, though, childhoodness was not a constraint to Jordan. Childhood simultaneously carried weight for her in the present as well as a promise for the future. Jordan asserted that being educated during one's youth is crucial so that the future will have adults who are able to lead with the knowledge necessary for true equality and justice. Although the present looked similar to what Jordan knew of the past, she assumed a personal responsibility for being ready for the future.

To Be Critical or Not to Be

Every child is not faced with the same desire or "calling" to participate in activism and community organizing. Not every child watches the killings of Black people on tv and social media and sees resemblance between the victims and themselves or their family members. As described in Chapter 3 where I used critical race theory to deconstruct the disciplines of science, the tenets of the theory are equally relevant to unpack how Black children are disproportionately forced to experience and attempt to make sense of racism in the U.S. Just as whiteness as property can be used to expose the ways that whiteness governs the fields of science, in similar

ways, using whiteness as property as a lens reveals how white supremacy infiltrates all systems in the U.S. determining how laws are established, how people are held accountable (or not), and who has the luxury to not think about these things in their daily lives. Black girls, because of their intersectional identities, and the histories of Black girls and women in the fight for racial justice, are not granted this luxury. And honestly, is this—the ability to "not see color" or be oblivious to anti-Black racism—a luxury that we as critical scholars would wish upon Black girls, Black children?

Because Black children are socioculturally, historically, and politically situated, I argue the answer to this question is no. The criticality birthed from Black childhoodness stitches an informed empathy, fuels a fight and resilience, and motivates an imagination for radically new worlds. Much change has been achieved within the U.S. and globally because Black youth (e.g., Black Panther Party, the Student Nonviolent Coordinating Committee (SNCC), NAACP Youth Council, The Student Organization for Black Unity, etc.) are critical of the institutions that disenfranchise their community and used their criticality to fight for justice. Black children like Jordan have been necessary contributors to progress.

I would be remiss if I did not also foreground the labor, fatigue, hurt, harm, and danger that Black children endure physically, mentally, and spiritually as a cost for having and acting on their criticality. But as knowledgeable citizens of the world with agency, how else should they respond? James Baldwin articulated it profoundly when he wrote,

> To be a Negro in this country and to be relatively conscious is to be in rage almost all of the time—and in one's work. And part of the rage is this: It isn't only what is happening to you. But it's what's happening all around you and all of the time in the face of the

> most extraordinary and criminal indifference, indifference of most white people in this country, and their ignorance (Baldwin, 1961).

I could add to Baldwin's words to also say, to be a Negro child in this country… Black children who are relatively conscious must also battle with an eternal rage. Jordan offers one example of what she chose to do with her rage, she chose to learn, educate, and advocate.

Jordan's Black Girl Imagination in School

Jordan, like many Black youth throughout history, had a desire to make a difference and was faced with a burden that should not be hers to carry. Her expressions of Black girl imagination revealed how Black girl childhoodness experiences can produce a particular criticality useful for forward mobility, but unfair for a child to assume as a personal responsibility.

Jordan attributed her commitment to justice as being cultivated in school. She attended a predominantly white high school that also had a middle school attached. She had attended the same school since 6th grade. When describing her school, she used words like "white-washed" to capture the curriculum and the ways topics related to race had been discussed in her classes. She told me that the only time they "talk[ed] about race [was] during Black History Month."

When first attending the school, she felt that it was not sensitive to the plight of minoritized people because all topics related to racial diversity and history told from the Black perspective were either absent or inaccurately represented:

> …we don't hear about our struggles for real in history books. We just hear about like George Washington, and we only have one unit about slavery and stuff like that. All they really say there is that Abraham Lincoln freed the slaves and Harriet Tubman. That's all they talk about, you know. I was tired of it. I just wanted to get away from that and I

> wanted to focus more on how hard it was for him to free the slaves; how he didn't even want to at first but he only did it so the North wouldn't be so upset, and the Union could come back together. I didn't want to just hear that it was easy for him to free the slaves, blah, blah, blah, blah. Like slavery is over and we're all free. No, we're not free!

Jordan's wrestling with time persisted in that moment as she articulated the ways her predominately white school misrepresented history by distorting the past to erase Black people and their lived experiences.

Although the curriculum she originally encountered in her middle school years was dismissive of the Black reality, Jordan was knowledgeable about the true history. She attributed this to her participation in the Black Student Union (BSU) at her school, which she joined during 7th grade, the year of its inception.

In efforts to "get away" from the illegitimate teachings of the classroom, Jordan sought refuge in the BSU. She joined in hopes that as a group they could "educate more people" and "everything would like, not everything, but things would kind of change a bit" in her school.

When discussing her participation in the BSU, Jordan lit up. She spoke with pride and joy. A hope for the future exuded from her through my computer screen. Jordan described the BSU as an organization that had participation from a diverse range of students. She said, "even those athletic boys who don't participate in clubs or whatever" are members of the BSU. BSU membership was also "open to white people who want[ed] to come in."

As a diverse group of students, they informed their school community of "stories of Black people who were either really successful for their day, or people like Trayvon Martin [and] Eric Garner, who didn't get to live to see their full potential and were killed unjustly." They also hosted fundraisers.

Jordan was most proud of the more recent protests and vigils they organized for their school and surrounding community:

> Early in June, we set up a vigil for… it was mainly for George Floyd, but it was for like everyone who died unjustly by the hands of police officers. We made a whole bunch of signs. We had a whole bunch of speeches saying like, this is not okay. We had a bunch of discussions saying why it wasn't okay. Yeah, that was nice! So, we got to set it up. We had a bunch of approval, obviously, but a lot of people showed up, which was good! Like, I don't know. I was hoping that a lot of people would show up, regardless of what their race is. That was nice. And yea, we do stuff like that.

For Jordan, her participation in her school's BSU was a manifestation of a personal conviction she had that her voice and position as a Black girl in her childhoodness were capable of invigorating change in her school and her community. I was not at all surprised by Jordan's conviction because of the person she had expressed herself to be during our two weeks together.

Jordan's expression of her Black girl imagination was not present without an emotional response. Throughout the two weeks she often spoke from a space of care and concern for others' happiness and wellbeing as if she was fighting for someone in her family. She also spoke about how she had been emotionally affected by the current events.

> With the whole Black Lives Matter thing, I've been more aware. I am little more paranoid when I drive by police just because like it's a subconscious thing rather than, just like… I don't know. I just get a little more nervous about stuff. It's kind of... it didn't really hit too close... it did hit close to home, but not really because of experiences, but I could just think of times when like, I remember my cousins getting pulled over. I was really scared for them. It's just like bringing back a lot of like memories and stuff.

Jordan was passionate about the state of racial equity in the U.S. because it was personal for her. When she looked at George Floyd or Ahmaud Arbery or Breonna Taylor she could see someone in her family that looked like them. Jordan's expression of her Black girl imagination was fueled by a love for those around her and a belief that change is possible. She was committed to being a part of that change.

Jordan's Articulations of Self

The ways Jordan described herself explicitly and implicitly through her artistic expressions and program contributions revealed alignment between how she expressed her Black girl imagination and her articulations of self. On the very first day of Empowering Girls Through Art & Science, I asked the girls to participate in a quick get-to-know-you game called Run and Go Get It as an icebreaker. The girls were asked to run and go get an item in their homes that represented who they are. They then had to use that item to introduce themselves to the group.

"On your mark, get set, go! Run and go get it!" The Zoom screen that was originally populated with beautiful faces of all shades of brown was left empty as the girls rummaged through their homes to find something worth sharing.

> "Hi, my name is Jordan. I brought some headphones because I really like music. I'm always listening to it and I'm always making playlists and stuff like that… My favorite kind [of music] is rap, but sometimes I'll listen to other stuff too."

Jordan was one of the last to introduce herself during the icebreaker and she seemed a bit timid to share at first. But when she spoke, she did so with a sense of clarity and authority. My initial interpretation was that she had a quiet confidence. I soon learned that my first impression of Jordan wasn't far off from how she described herself:

> I'd say I'm determined, friendly, and focused… I say determined because… so like with most things, if I start it, I'm going to finish it. I don't really like quitting things. Like with sports and stuff, even if I don't really like it, I'm going to finish it, if I start the season and stuff like that. And like I just don't really quit. I just don't quit. I say, friendly, because I'm kind of… I'm pretty social. Even though I'm kind of shy when meeting someone at first, after a while, I get like used to them. Yeah, I like opening up my circle. I say focused because I don't really slack off. When I'm doing my homework or doing work in general, I don't really like getting distracted too easily. I kind of just like stay in the zone until I finish. That's why I don't really like doing homework at school because I know my friends are going to try to distract me. I like to be alone, in the zone so I can just like finish it, you know?

Jordan was clear about who she was. What I experienced as a quiet confidence on Day 1 of Empowering Girls Through Art & Science could have been a result of the shyness she referenced "when meeting someone at first."

Throughout our two-week program, I learned that in addition to her starting off a bit timid and being determined, friendly, and focused, Jordan also enjoyed playing on the volleyball team, recording TikTok videos, cooking, and making her friends laugh with her unique sense of humor. Jordan shared that she was a Christian, that she could sometimes be dramatic, and considered "being considerate" her favorite quality about herself:

> My favorite part [about being me] is how, I'd say, how considerate I am, I guess. Like so, for Christmas, Mother's Day, Father's Day, stuff like that… Well Christmas, specifically, I don't really think about presents I'm getting, like I'm receiving. I really put a lot of thought into the gifts I give. Even though they might not be the most expensive because

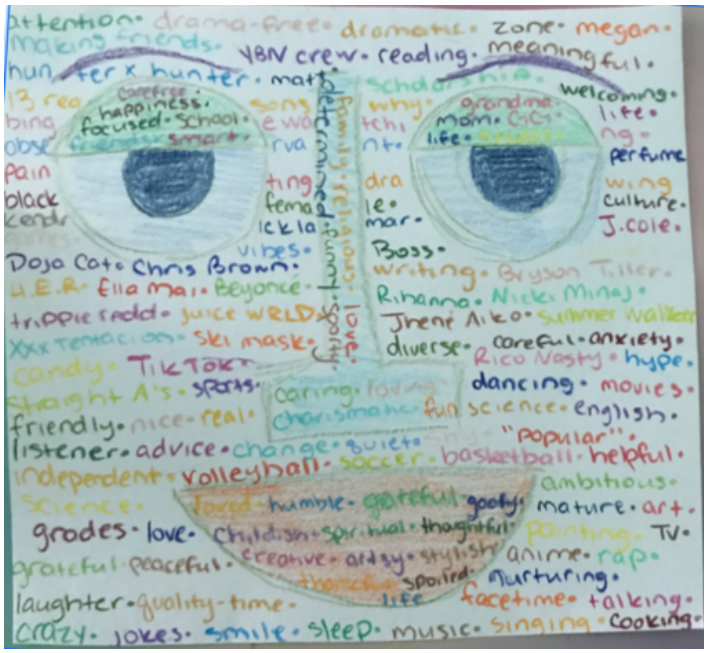
like I don't have a job (Jordan and I both laugh). I still try to get everyone what they want and what they like and what they love. Receiving gifts is fun and all, like obviously, but I really do put a lot of thought into gifts I buy. Actually, I like buying stuff for people.

Jordan enjoyed "seeing happy people" and especially enjoyed when she could be "the person making them happy."

In her self-portrait in figure 5-11, Jordan visually represented all the characteristics that make her who she is including the things she liked to do, musicians she enjoyed listening to, and shows she enjoyed watching. The various words written within her self-portrait illuminated her vibrance, complexity, and depth.

Figure 5-11

Jordan's Self Portrait



What stood out to me among all the words included on Jordan's self-portrait was "Black female." Those two identities seemed to not only motivate the criticality manifested in her commitment to activism and organizing in her school, but also inspired when and how she participated in our program. Jordan's interpretations of what it meant for her to be a Black girl

and live the associated intersectional experiences were salient daily. She consistently joined (and often led) conversations during Empowering Girls Through Art & Science when they centered on race and gender and the intersections of the two.

When asked what it means to be a Black girl in society today, she responded:

> To me [being a Black girl] means, well it means multiple things. On the positive side, it means, if I make a difference in the world, I feel like it will mean more to me, because I'm a minority and I get discriminated against in both ways, being Black and being a woman… it's kind of harder for me to make an impact in the world because I am a Black woman. So, there are many factors that play against me. I mean in America, specifically. Obviously, it's possible for a Black woman to make an impact. Many of them have, but there are definitely struggles that come along with it. You have to know how to deal with those struggles. I feel like if you want to make an impact in the world, you have to know how to deal with struggles. You have to know how to deal with like downsides, because no one gets… you can't just get to success without struggles and without your weaknesses and stuff like that. So, I just feel like it's harder… but it's still like special…

Jordan was clear about who she was, how she identified herself, and the labor involved with being Black and a woman in America. She was working through ways to be visible as a Black woman and Black girl despite the ways the world she lives in might "play against" her.

When listening to her speak in-the-moment, I jotted in my notes and used underlines to emphasize my thinking, "she uses Black <u>woman</u> to describe herself and not Black <u>girl</u>. <u>Interesting</u>!" Although she did distinguish between childhood and adulthood from the perspective of financial accessibility during our interview, here she attended to a shared experience she believed she had with adult Black women. In describing her experience, she

reflected on the correlation between Black womanhood and struggle, which, whether you are a girl or woman, is impossible to escape. The conflation between womanhood and childhood is not to be overlooked. As much as Black girlhood studies scholars warn about using Black feminist thought to theorize about Black girls' experiences, because of the risk of eclipsing childhood for adulthood, Jordan was doing that work herself. Although she was asked what it meant to be a *Black girl*, she responded by referring to herself as a Black woman. The act of denying one's childhood is not only an external endeavor. Jordan illuminates that as Black girlhood studies scholars continue to theorize about Black girlhood, recognizing the adultification that some Black girls have internalized can be a part of the Black girlhood experience.

In her Basquiat inspired illustration in figure 5-12, Jordan describes the benefits of being a Black girl, including Black girl magic, no rules, love, happiness, and teenage life. She was intentional about highlighting the beauty associated with Black girlhood.

Figure 5-12

Jordan's Basquiat Inspired Illustration

Jordan's Meaning Making of Science

Jordan brought the same critical lens that inspired her participation in the BSU and fueled her understanding of intersectional discrimination to participate in discussions about science in our program. It was Day 9 of Empowering Girls Through Art & Science. The PM group and I were engaging in a thought-provoking conversation about whether science was guilty of the harm caused to Communities of Color. Jordan was presenting for her group, offering their case for the Who Done it?! Is Science Guilty? learning task. During this presentation, her group was responsible for teaching everyone else about the sterilization of Black women. They were also tasked to plead their case, stating whether or not they believed science was guilty of the harm caused to Black women in this historical event. Jordan explained:

> Black women were harmed and sterilized against their will. Mainly poor Black women were the ones targeted…Science was not involved because the root reason was for racism and not really for a scientific purpose…Organizations were the ones that sterilized the Black women without their knowledge…I feel like science originally created it for people who wanted to be sterilized and they just didn't want to have babies and stuff. The scientists who made it probably weren't trying to do harm and they just wanted it just in case people wanted to be infertile and didn't want to have kids. But the government and health administrations got it in the wrong hands. They started to make it so that it was harmful.

Jordan and her group were setting up their case to claim that science (and the scientists) were innocent. They were making the case that "the government and health administrations" should be charged with the horrific crime. They were the third group to present and the third group to argue that science was innocent. Jordan was convinced that the hurt and harm caused

was not a result of an irresponsible system, but simply a result of poor decisions by individuals. This conversation about the innocence of science led to a larger discussion centered around the question, what is science? I realized this needed to be discussed before the girls could make informed decisions about the state of science in their cases.

Ideas about science being another word for nature and science being the process of exploring nature were the two competing ideas circulating in our virtual space. During that moment, the girls were the most participatory they had been throughout the two weeks. Most girls remained off mute, with their cameras on, freely engaging in conversation to the point where they would unintentionally cut each other off. They were so eager to share their opinions. Jordan was as eager to share her perspective, particularly after I offered:

> This is interesting because you all have opened my eyes. I had my own opinion and maybe you can kind of tell what my opinion was by the questions I'm asking, to the question is science guilty. And you all are making this distinction between science in and of itself and the doing of science is an interesting one. That's a very nuanced idea, complicated idea, being able to tease it out. So, let's take it to what's happening in the world today. So, is our legal system bad or is it just the way police officers are using our legal system on Black men and women, people of color that makes it bad? You see how I kind of made the idea? Is it synonymous to the science question? I don't know. You have a legal system. You have laws. You have rules. You have ways of doing things, right? The police, they say they *are* doing that, you know. What are your thoughts?

Jordan quickly replied:

> Well, personally, I do feel like the legal system as a whole is bad because it's not only police officers that are doing wrong things, like judges, juries, and stuff. We can tell that

> some Black men are...like a lot of Black men are getting not only falsely accused, but they also have to go to jail longer than white men sometimes. They just get worst punishments for sometimes even petty crimes, like drug dealing or like weed and stuff like that. But then we can see that, like a whole bunch of school shootings. I don't want to come off really blunt, but I've noticed that a lot of school shooters tend to be white men and they always say, "Oh he's sick. Oh, he's not mentally there." But then we see Black men getting arrested for years because they had weed on them. So, I just feel like as a whole, the whole system is bad and not just police. Police are bad too! But I just feel like as a whole it's bad. So, yeah.

Jordan brought her critical perspective to our conversations about science, but she was not using this lens to reconceptualize the definition of science she held prior to our program. She recognized the legal system to be an institution that systematically causes harm to Black Americans, but she did not use that same rationale to unpack the ways science had been deployed in the Black community to cause harm. Jordan bought into the narrative of science and struggles to rethink what she already has learned in school. She is a pursuer of the disciplines and has a desire to be an anesthesiologist. So much so that she decided to "double up on science" during her 9th grade year, taking both Intro to Biology and Intro to Chemistry. The only exposure to conversations about science take place in school and are dictated by how the school chooses to present science to students. Her mom is a nurse and serves as a source of knowledge as she asks her "about certain scientific anatomy things."

Jordan expressed her Black girl imagination in a variety of ways during Empowering Girls Through Art & Science. She expressed her imagination in the ways she conceptualized time and the way that time disappoints *and* holds possibility for the future all at the same time.

She also expressed her Black girl imagination in her ability to have hope for the future although she mentioned the present as having many of the same problems of the past. Jordan's critical perspective was revealed in her desire to join her school's BSU and push for change in her school and in her community. Her criticality also was visible in the ways she critiqued her school's curriculum. Lastly, Jordan's distinction and conflation between childhood and womanhood revealed the multifaceted nature of her Black girlhood experience and to articulate Black girlhood, requires a recognition that some girls can consider themselves older than they are in some cases and assume childhood roles in others. Jordan has required a redefinition of what Black girl childhoodness to include the tension that can exist between childhoodness and criticality and childhoodness and adulthood.

Chapter 6
Discussion & Implications

In this chapter, I present a summary of the goals of this study and what was achieved, revisiting the three research questions that guided the study. I then step back to highlight key areas of learning that I had as the program designer, facilitator, and researcher. I also highlight the ways this study offers new contributions to the field of science education. I conclude the chapter by outlining implications for classroom science teachers, teacher educators, and my fellow science education researchers and scholars.

Study Goals and Achievements

This dissertation was designed to achieve three goals. The first was to offer the field of science education an opportunity to disrupt the perpetual marginalization and misrepresentation of Black girls in schools by pausing, noticing, and thinking critically about who Black girls say they are and how they express themselves. I paused and noticed in intentional ways in order to listen to Black girls as they shared their experiences and as they learned, imagined, and created. In listening, I also sought to see and experience the diverse forms of Black girlhood which are often overlooked and misunderstood in U.S schools. The second goal was to foreground three of the Black girls in the study, Chloe, Elaine, and Jordan. I focused on their articulations of self and their meaning making of science as they engaged in an informal science program that prioritized the positive visibility of Black girls, promoted critical exploration of scientific histories, and sought to nurture Black girl imagination. The third goal was to identify the ways these three Black girls actualized their Black girl imaginations through expressions of childhoodness,

creativity, and criticality. To do this, I centered my exploration on Lawrence-Lightfoot's (1995) guiding question, "What's good here?" This question has as its imperative to create space to see the Black girls' strengths, capacities, and agency, their wisdom, virtue, and possibilities. I employed portraiture methodology (Lawrence-Lightfoot & Davis, 1997) to seek out what was good, what was working, and what has yet to be shared in academic scholarship about the goodness of Black girls as they engage in knowing, interacting with, interpreting, and learning science.

As I paused and noticed, explored the three focal girls' science experiences closely, unpacked the Black girl imaginations they displayed, and sought to identify the good, the following research questions guided the study:

1. How do adolescent Black girls express their *Black girl imaginations* when participating in a critical, informal science learning space designed with them in mind?
2. What do their expressions of *Black girl imagination* reveal about their articulations of self?
3. What do their expressions of *Black girl imagination* reveal about their meaning making in science?

To achieve the goals outlined above and to build clarity around my three research questions, I began this dissertation by articulating the current contexts of Black girls in U.S. schools, using the concept of omnivisibility as the organizing frame. The foundational argument of omnivisibility highlights that Black girls must not only simultaneously navigate being both invisible and hypervisible in schools, which has been explained by a host of scholars (Gholson, 2016; Jacobs, 2017; Carter Andrews, Brown, Castro, & Id-Deen, 2019; Love, 2019); Black girls must also navigate spaces of positive visibility because of their own self-advocacy, the rearing of

strong Black families, and the support of teachers who believe in their beauty and brilliance. Similar to the omnivisibility that Black girls navigate in schools broadly, Black girls are also tasked with navigating the omnivisibility in secondary science learning spaces, where they need and deserve more opportunities to be positively visible for their own sake. My use of omnivisibility as an organizing frame informed the goals of this study, the choice of methodology, and the presentation of findings as portraits overflowing with opportunities to see, hear, and learn from Chloe, Elaine, and Jordan without alteration.

My conceptual framework consists of three intertwined theoretical fields of study: Black girlhood studies, critical race-informed science education, and afrofuturism. Within a Black girlhood studies frame, I began by acknowledging that Black girls occupy unique intersections of race, age, gender identities and expressions, sexuality, and socioeconomic status (Smith, 2019). I also argued that the unique intersectional identities of Black girls differ and must not be conflated with the experiences of Black women when they were once Black girls. Instead, Black girls' liminal perspectives inspire a particular creative capacity and produce a critical lens that fuels their own opinions about the world. These realities necessitated separate presentations of Chloe, Elaine, and Jordan. Although there are similarities among the three girls, their intersectional identities differ in important ways, producing varied personalities, diverse creative expressions, and critical views of science and society deeply influenced by their personal lived experiences.

I used a critical race-informed science education frame to unpack the ways that the disciplines of science as well as the teaching and learning of science in K-12 classrooms are innately racist, sexist, and designed to celebrate and perpetuate knowledges produced in white, Westernized communities, while all other knowledges produced in communities of color are

deemed irrelevant and un-scientific. The two tenets of critical race theory that informed this framing—colorblind racism and whiteness as property—inspired the five critical shifts necessary for revolutionizing science education to move Black girls from the margins of science learning to the center (see Chapter 3). This framing was instrumental to the design of Empowering Girls Through Arts & Science curriculum because it prompted activities that sought to uphold the five critical shifts. The most engaging activity during the two weeks was the "Who Done It?! Is Science Guilty?" learning task, which engaged the girls in wrestling with the exclusion of these histories in mainstream science. They also were learning about topics that center Black people but are typically omitted from K-12 curricula. Using the critical shifts as guidance for the curriculum and my instruction enabled Chloe, Elaine, and Jordan to feel empowered as they attempted to define "science" and determine whether science was guilty of the harm caused to communities of color.

Afrofuturism celebrates the Black imagination and its manifestations in science fiction and other forms of creative expression. I argued that afrofuturism expands what can be considered scientific because it challenges us to redefine where science takes place, what science is used to accomplish, and who is considered scientific. I also engaged with the complexity of time and the way afrofuturists describe the interdependence of the past, present, and the future. I used this theoretical lens to inspire the organization of the program curriculum. The curriculum offered opportunities for the girls to think about the past. The Learning From the Past and the "Who Done It?! Is Science Guilty?" learning tasks were designed to support the girls in exploring the past. The Instagram Intervention and Black Women in Science Today learning tasks were designed to support the girls in thinking about the present, exploring Black women who are currently (or were recently) scientists in the field. The comic book or children's book

artistic expression provided an opportunity for them to think futuristically about Black girls in science, not being bound by the limitations they articulated. I also used afrofuturism as an interpretive lens to make sense of what I learned from listening to the girls. For example, conversations that involved generational affiliation, time, past, present, or future became even more meaningful when considered in terms of afrofuturist temporal relations.

I used my conceptual framework to argue that Black girl imagination is an underexplored characteristic of Black girlhood that emerges when Black girls can exist in a space where they are seen and nurtured. Imagination can be an attribute difficult to study and analyze because it is a rather abstract characteristic. Using Black girlhood studies as a guide for elevating Black girl voice in concert with afrofuturism, I was inspired to use childhoodness, criticality, and creativity as tangible ways to identify and analyze Black girls' imagination. Understanding that Black girl imagination is often stifled in secondary science classrooms made it a worthwhile task to cultivate a space for Black girls to be children uninterruptedly, to nurture their creativity, and to position their critical perspectives of the world as legitimate.

Study Achievement: Offering Counterstories of Black Girls in Science

The paramount achievements of this study lie in the counterstories I present of three Black girls as they made meaning of the world around them during an informal science program. These counterstories of Black girlhood in science, in the form of portraits, were birthed from who Chloe, Elaine, and Jordan expressed themselves to be, what they had in common, and, most importantly, what made each of them uniquely themselves. As Chimamanda Ngozi Adichie (2009) warns us in her TED Talk, there is danger in relying on a single story to describe any group of people, particularly groups of people who have been historically marginalized and misrepresented. In my pursuit of goodness in this study, I was in search of new stories; not just

one story, but multiple stories that centered Black girls and was informed by their unique expressions of childhoodness, criticality, and creativity As I wrote the portraits in Chapter 5, I hoped that readers would recognize the variability of Black girlhood as embodied by Chloe, Elaine, and Jordan. They were all adolescent Black girls during the summer of 2020. They were all enrolled in Empowering Girls Through Art & Science virtually. They were all curious and thoughtful about the world around them. And they were also all different from one another in significant ways. Highlighting their distinctiveness in these portraits counters normative assumptions about a monolithic Black girl experience and identity.

In the section below, I reiterate the dominant narrative surrounding Black girls in U.S. science classrooms and in science education research. I follow that narrative, by articulating what was learned about Black girls through the presentation of counterstories in the form of portraits.

The Dominant Narrative of Black Girls in Science Education

The dominant narrative of Black girls in U.S. science classrooms exists but is underdeveloped because Black girls have been systemically ignored and erased. Educators and various stakeholders in the fields of education know very little about the experiences, hopes, and challenges of Black girls, including those in science education (Gholson, 2016; Ward & Robinson-Wood, 2006). Black girls are pervasively denied access to high-quality science learning experiences in U.S. schools. Schooling structures that govern who have access to advanced, honors, and rigorous STEM classes keep Black girls and women invisible and in the shadows. As a result, productive research and practice-based conversations that seek to better understand how Black girls engage in science learning remain at the margins (Jacob, 2017),

maintaining a limited research canon about Black girl beauty and brilliance in science learning spaces.

The common narrative of Black girls in science education research consists of them being invisible (not present in the research at all) or rarely represented, reducing their involvement to scholarship centered around altering Black girls to "give" them access to science by making *them* more palatable for the fields of science. In these types of studies, Black girls are centered in science education research only when they are seen as the problem to be fixed, as a group that needs to be motivated to do science, or as exceptional in a small number of cases, all of which reinforce the dominant marginalizing narrative. A disruption of this narrative about Black girls is imperative because Black girls hold a wealth of knowledge that we can learn from by listening to them. Black girls are key contributors to their communities, are thinking deeply about the world around them, and they simply just deserve to be seen without alteration or interruption because they are human.

Learnings From Counterstories

Much can be learned from the portraits of Chloe, Elaine, and Jordan. The counterstories confirm that Black girls think deeply and critically about the world around them. The three portraits reveal that Black girls have opinions about the histories of science and how race intersects with those pasts. In typical science learning environments, they are not given the opportunity to engage in similar topics, but it was apparent that they were invigorated by the discussion prompts. This is advantageous for their science learning because it allows them to think critically about the ethical obligations associated with science doing and provides them with opportunities to see how Black people have interacted with or been affected by science in the past.

Additionally, the counterstories make plain that Black girls are able to grapple with multiple epistemologies of science. They were briefly introduced to additional epistemological orientations to science by exploring Aboriginal medicine, Adinkra art, and the Egyptian pyramids. Their ability to explore those topics while holding on to the learning of science gathered in school showed that the girls were able to learn about knowledge developed in Black, Brown, and Indigenous communities without jeopardizing their ability to learn and recall normative science concepts. It was also motivating that the girls were curious and interested to learn about the histories of science to enhance what they were learning in school.

Finally, the counterstories reveal that science learning can be productive even if it deviates from the performance expectations or the three dimensions of NGSS, crosscutting concepts, disciplinary core ideas, and science and engineering practices. In efforts to center Black girls and their ways of knowing and being, it is productive to supplement secondary science curriculum with opportunities to learn about Black women scientists and to unpack some of the unethical treatment experienced by people of color for the advancement of science. Such opportunities make it possible for Black girls to see themselves and their community as an active contributor to the field and its impacts.

Expanding Black Girl Childhoodness, Criticality, Creativity

Historically and contemporaneously, Black girls have systemically been denied opportunities to experience and enjoy childhood, express their criticality, and utilize their creativity in spaces traditionally reserved for the teaching and learning of disciplinary content knowledge. The data reveals that Empowering Girls Through Art & Science offered a space for Chloe, Elaine, and Jordan to express their childhoodness, criticality, and creativity in ways that were organic to them. In addition to the portraits of Chloe, Elaine, and Jordan serving as

counterstories for Black girls in science, the findings presented within them expanded my understanding of childhoodness, criticality, and creativity. In the next sections I explore the ways my understanding of these three components of Black girl imagination were further developed based on my work with the girls and by my analyses.

Black Girl Childhoodness

I use Black girlhood studies to describe Black girl childhoodness as the amalgamation of experiences that Black girls have as they occupy the unique intersections of their identities (e.g., race, gender, class, and age) coupled with their generational affiliations, proximity to technological advances (and social media), geopolitical locations, and locations in the world (Smith, 2020). Black girl childhoodness centers moments of joy, play, innocence, and the ability to take risks and learn. I approached the research study expecting to see Black girl childhoodness being expressed in laughter, the telling of inside jokes, and efforts to grapple with new ideas.

My findings extend the counterstory I set out to tell at the beginning of this study by confirming that Black girls experience childhoodness in a variety of ways. Black girls, due to the history of being young and Black, experience childhood in more mature ways when compared to non-Black youth. Childhoodness for Black girls cannot be described with rose colored glasses, because they exist in a society overwhelmed by racism and patriarchy. Black girl childhoodness must be defined by understanding that Black girls often experience elements of childhood and adulthood simultaneously. Some girls, particularly Jordan in this study, interchangeably refer to themselves as Black girls and Black women. I argue this is a manifestation of the perpetual denial of childhood that Black girls have experienced *and* Black girls' desire and ability to participate in experiences some may deem inappropriate for their age. For example, Jordan was invested in the fight for racial justice, although this is a fight she did not initiate, and it should

not be her responsibility to participate in. As a Black girl, she was motivated to join the cause. Elaine, in her childhoodness, was able to grapple with overwhelming concepts in such a thoughtful way. As she acknowledged the limitations placed on Black girls, she was able to also think beyond them with a stability that many would not attribute to children.

Black girl childhoodness is not completely defined by the overlap between childhood and adulthood in this study. It was also apparent in the data that Black girls are also simply just being children. Chloe, Elaine, and Jordan expressed that they enjoyed hanging out with friends, playing sports, and being creative. Black girls are complex individuals who think deeply and critically about the world around them. Developing learning environments that nurture Black girl childhoodness requires opportunities for them to not be constrained by stereotypical versions of how others define it, but they should prioritize space for Black girls to define it for themselves.

Black Girl Criticality

At the onset of this study, I present Black girl criticality as being defined by Black girls' abilities and desires to advocate for themselves and others because of their liminal understanding of the structures that have been designed to disenfranchise them and those in their communities. I acknowledge that Black girl criticality asserts that Black girls are watching, they are listening, they are experiencing the world around them, and they have opinions about it all. I argue in Chapter 3 that Black girls have legitimate critical lenses and have ideas that can inspire ways forward for a better future.

After I conducted the study, my original ideas were, in part, confirmed. Chloe, Elaine, and Jordan had strong opinions about racism, colorism, stereotypes, social media, their education, etc. In their criticality, they also articulated ways they could advocate for other to move toward a more inclusive future. As I concluded my analysis, I also realized that my initial

understanding of Black girl criticality was limited. By presenting a view into a science learning space that allowed for Black girls to question the neutrality of science revealed the process that Chloe, Elaine, and Jordan engaged in as they considered the intersections of racism and science. My understanding of Black girl criticality and how to develop a learning environment that nurtures it was also enhanced.

I observed Chloe, Elaine, and Jordan grappling with the ways individuals influence how systems impact others. I observed them wrestling with racism in society and how it complicated their understanding of racism operating in the fields of science. I observed them utilizing their criticality to make sense of the histories of science in ways they had not been asked to do so before. My understanding of Black girl criticality expanded as I understood how offering topics like the histories of science enabled them to embed their Black girl criticality in a space where it is typically not welcomed. Typical science learning environments rarely offer opportunity for Black girls to incorporate their intersectional identities into learning the content. Through their engagement, Chloe, Elaine, and Jordan revealed that they were ready and capable of using the knowledge gained outside of science (e.g., knowledge about systemic racism, justice, need for prison reform, inequities in the legal system, etc.) to enhance their learning within a science learning context.

My understanding of Black girl criticality has also expanded as I began to understand the ways Black girls have internalized the learnings received in school. In addition to their ability to grapple with multiple ways of knowing, I have learned that they indeed have internalized the learnings offered in school. This is not surprising. They have been emersed in Western, Eurocentric representations of science throughout their academic careers. Science is also presented in society in complimentary ways. To nurture Black girl criticality in science, it

requires that learning environments are developed with ongoing opportunities for the girls to think deeply about the topics. It requires scaffolds and intentional curricular choices that support the girls in thinking about the systemic nature of science and the ways Black, Brown, and Indigenous people show up within it.

Black Girl Creativity

I use elements of Black girlhood studies and afrofuturism to described Black girl creativity as Black girls' ability to create something new out of something old or out something that may have never existed. Black girl creativity can be expressed as visual art, literary art, performance art, new languages (slang), fashion, hairstyles, make-up trends, ways of being, etc. I acknowledge that Black girl creativity also exists beyond artistic expression even in spaces where no "art" is produced. Black girl creativity holds great power as it has the ability to shift culture. I approached this dissertation study expecting to see Black girls expressing themselves and their learning creatively through the artistic expressions and art meditation in the curriculum. I expected to see the girls possessing a variety of artistic skills and styles and their creativity being express in diverse way.

Chloe, Elaine, and Jordan used the artistic expressions and art meditations as opportunities to express themselves and their learning. Their creative expressions offered a lens into their minds that gave me access to extensions of themselves I did not fully see in the program. They shared more specifics about their personalities and illustrated their critical perspectives. Creativity embedded in the curriculum offered the girls an alternative language to communicate their ideas, whether they considered themselves to be artistic or not. My understanding of Black girl creativity now includes its ability to be an extension of oneself. It

can serve as an external representation of how Black girls feel, think, and reveal what they desire.

My understanding of Black girl creativity in science learning has also evolved. I am now confirmed that Black girl creativity is relevant to secondary science learning. NGSS acknowledges eight science and engineering practices. NGSS describe these practices as the "behaviors that scientists engage in as they investigate and build models and theories about the natural world and the key set of engineering practices that engineers use as they design and build models and systems" (NSTA, 2014). After exploring the ideas Chloe, Elaine, and Jordan shared in their art, I am left wondering about the role of creativity as an additional practice integral to culturally relevant science learning and doing. Through artistic expression I was able to gather a wealth of knowledge about Chloe, Elaine, and Jordan and their meaning making of the content explored in the program. Artistic expression is an underutilized method of communication in science learning. If incorporated, it could provide additional entry points for Black girls who may struggle seeing themselves represented in the science learning process. My understanding of Black girl creativity now includes its ability to make science more relevant to some Black girls and expand the practices of science to include ways of expression that are steeped in cultural ways of being.

A Layered Counterstory

The more deeply I dug into the process of centering Black girls and expanding my understanding of Black girl childhoodness, criticality, and criticality, the more I understood that offering counterstories of Black girls in science requires multiple layers of counterstories. To elevate the diversity of Black girls' experiences in a science learning space, I had to think differently about how science has been normatively defined, how science learning typically

looks, and who typically teaches it. Presenting authentic counterstories of Black girls in science necessitated a strategic combination of multiple counterstories working together to center marginalized stories and ways of storytelling across several aspects of the research process. When multiple counterstories are combined, a more authentic counterstory can be told.

Who is Doing the Teaching? A Counterstory of Science Teaching

One layer of the counterstory offered in this dissertation involves redefining who teaches science. Statistics show that almost 80% of teachers in U.S. public schools across subject areas are white women (National Center for Education Statistics, 2018). Nationally, about 60% of middle school and high school science teachers identify as white women and 28% as white men (National Center for Education Statistics, 2016). Research also shows that in addition to a majority of teachers being white and female, the level of education, experience, and preparedness across school districts varies, with school districts that serve Black and Brown children employing the least trained and experienced teachers. Black girls are in science classrooms typically taught by white women who have limited training and experience working with Black youth.

To develop a layered counterstory that elevates the stories and experiences of Black girls I reconsidered the typical story of who teaches science. At the onset of this dissertation, I knew I would be facilitating the program, but as I reflected on design decisions made, a counterstory emerged. As a highly qualified Black woman scientist and educator, I served as the program designer and facilitator for Empowering Girls Through Art & Science. Having a Black, well-educated, well-trained teacher leading a science learning environment is a counterstory. My identities contributed greatly to how I approached facilitating the program. For example, one key distinction I made preparing for the program was viewing myself as a facilitator rather than a

teacher. To avoid what Freire (1968) describes as the banking model of education, I assumed the posture of being the facilitator of a group of knowledge-bearing individuals rather than being the sole bearer of knowledge seeking to bestow that knowledge on the empty vessels of students. Typical science learning environments position the students as passive receivers of knowledge while the teacher or the textbook has all the knowledge to share. My approach offered as it empowered the girls as knowledge bearers whose understandings were critical to the group's learning. It also offered them an opportunity to learn with a Black woman as facilitator.

What Science is Considered Worth Teaching? A Counterstory of What is Learned

Another layer of the counterstory exists in the curriculum taught in the program. The content explored in Empowering Girls Through Art & Science differed from the science content typically taught in K-12 schools and differs from the content deemed worth learning by the Next Generation Science Standards (2013). The content I deemed worthy of being taught in Empowering Girls Through Art & Science was content that centered Black, Brown, and Indigenous stories. The science taught in the program aligned with what Rodriguez (2015) deemed valuable for children to know beyond the performance expectations outlined in the science standards. Rodriguez identified the need to include dimensions of engagement, equity, and diversity practices into the NGSS to make science learning more culturally inclusive.

The science presented in the program allowed the participants to explore science from not only a culturally relevant perspective, but it also offered opportunities for them to actualize their capacities for critique. The curriculum centered the experiences of Black and Indigenous people historically and contemporaneously to provide the girls with opportunities to think critically about the ways non-white people are integral to science. The curriculum presented a counterstory by providing the girls an opportunity to grapple with the relationship Black people—especially

Black women—and Indigenous people have had with science across time. For instance, one activity that was central to all three portraits was the "Who Done It?! Is Science Guilty?" activity in which the girls were responsible for determining if science was to blame for the harm caused to Black women and communities of color. This activity encouraged critical thinking. It asked the girls to consider the ways race might influence how individuals were treated. These types of conversations and learning opportunities are not found in the dominant story told in K-12 science classrooms, but these conversations were considered worthy of being prioritized in the program's curriculum. This layer of the counterstory offered space for the girls to freely grapple with culturally relevant topics and bring their criticality into a science learning space.

Who Gets to Define Science? A Counterstory of the Disciplines of Science

A third layer of counterstory concerns who gets to define science. The curriculum designed for Empowering Girls Through Art & Science also provided space for the girls to grapple with the definition of science. Typically, the definition of science or the definition of the specific discipline students are engaging in is told to them. It is not a topic of discussion. For example, on the first day of school, one of the first things a chemistry teacher might say is, "Chemistry is the study of matter in its simplest forms. Chemistry is all around you and is involved in everything that you do because everything in our world is made up of matter."

During Empowering Girls Through Art & Science, Black girls were asked to define science for themselves by being placed in a situation where they had to determine if science was guilty of the harm caused to communities of color. This layer of the counterstory presented in this dissertation elevated the autonomy and agency of Black girls in their science learning, deeming them worthy and brilliant enough to grapple with defining science on their own and determining whether it was guilty. The counterstory offered here was not designed to fully

replace the dominant science curriculum taught in schools. The moments presented were designed to offer new opportunities to learn that centered the stories of those typically omitted.

Dissertation Serves as Counterstory

In addition to each of the layers of counterstory described, the construction of the dissertation itself challenges the dominant forms in which research is typically reported. My choice to use portraiture as methodology shifted the goals and presentation of the dissertation in relation to traditional science-related research. For example, I chose to take up the interplay between creativity and empiricism in the presentation of this study by strategically using a narrative writing style throughout, particularly in developing narrative portraits to present study findings. I included artistic expressions as a source of data and as a complement to the overall manuscript. Typically, dissertations are black words written on white pages. I chose to include colorful artwork that elevated images of Black girls illustrated as superheroes, futuristic beings, and activists. The art adds additional interpretation of the arguments made in each chapter and offers an additional modality to insert my voice as researcher and portraitist throughout the dissertation. The dissertation as a whole serves as a counterstory as it positions Black girls as being capable of thinking critically about science and taking their perspectives as worthwhile contributions.

Implications

As articulated above, I have learned a great deal about Black girls and their meaning making of science. I am honored to have worked with 17 Black girls and to dig deeply into exploring who Chloe, Elaine, and Jordan expressed themselves to be. The opportunities received to better understand Black girl imagination in this dissertation should inspire others in the field of education to prioritize moving Black girls from the margins, the cracks, and the shadows of

science education, to the center. By centering Black girls and their imaginations, science education is able evolve and become a space that values its history, the history that begins before White men became the "owners" of the field. Science is able to become more colorful, more passionate, and more relevant to students' lives. In the follow sections, I have articulated the ways that stakeholders in science education can evolve based on the learnings presented in this dissertation. The implications for classroom teachers, teacher educators, and science education researchers will require disruption of what typical science learning and research entails. It will require boldness and the ability to do something different, to pursue a counterstory.

Classroom Teachers

Empowering Girls Through Art & Science was an informal science learning space. It can be tempting to surmise that the learning experience offered in the program is relegated to only being able to exist if it takes place outside of school hours. The weight of standardized tests, pacing guides, and teacher evaluations, are real and they often become the rationale for maintaining the status quo in science classrooms. I argue that the opportunities offered in this study are applicable to in-school learning environments. I urge classroom teachers to embed opportunities for students to engage in creativity as an option for expressing their learning. Utilize artistic methods, self-portraiture, Basquiat-inspired illustrations, Aboriginal dot painting, etc. as a method to incorporate non-white histories, and engage students in a varied form of communication. Embed stories and experiences of Black, Brown, and Indigenous people as they have explored the natural world, been harmed by science, and have contributed to it.

Bang & Medin (2010) argue that Indigenous children are able to navigate across multiple epistemologies of science as they learn about normative science and science from a perspective that is steeped in tribal histories. This study reveals that Black girls are also able to navigate

across various ways of knowing. I extend this argument to assert that children from all races and ethnicities possess the capacity to grapple with science from a variety of perspectives. The question I offer teachers is, are you willing to provide these learning opportunities for your children in your classroom? Learners will not have opportunities to engage in such critical learning opportunities in their science classrooms unless their teachers provide them. I urge classroom teachers to revisit the five critical shifts to revolutionize education in Chapter 3 and make substantial progress toward achieving each one.

Teacher Educators

For classroom teachers to feel empowered to revolutionize science education in their classrooms they must be given professional learning opportunities to grapple with these ideas themselves. Teacher education program must offer opportunities for novice teachers to grapple with similar ideas before they enter the teaching workforce. Science methods courses can evolve based on the findings in this study, by also incorporating similar learning tasks as the ones presented in the Empowering Girls Through Art & Science curriculum.

Understanding the racial demographic of U.S. teachers, the work must begin by supporting novice teachers in thinking about their own identities and their approximation to whiteness. This step is imperative, but particularly in science learning is insufficient if the learning and critical exploration stops there. Additionally, science methods courses must prioritize opportunities for teacher candidates to think about the ways that whiteness infiltrates the disciplines of science, and consequently perpetuate the exclusion of Black, Brown, and Indigenous people. After engaging with this dissertation, my hope is that engaging in science learning for "*all* students" becomes more detailed and intentional. Preparing teachers to be thoughtful of the "non-dominant groups" in a science should now involve more than aligning

lesson plans to NGSS. Based on the finding in this study, it now includes intentional curricular decisions that center and nurture Black girl childhoodness, criticality, and creativity. It involves embedding opportunities for artistic expression. It involves moments for children to engage with the histories of science that center Black, Brown, and Indigenous people. It involves recognizing Black girls and other students of color as knowledge-bearers, containing a wealth of knowledge necessary for the learning. Moments to learn and practice facilitating conversations like the ones encouraged in this dissertation must occur in teacher preparation programs.

Researchers

When scholars in science education articulate in research articles and books that we want to center historically marginalized communities (e.g. elevate Black girl, queer, Indigenous voices), we must ask ourselves, are we thoughtful of the ways that the methods used, our writing styles, intended audiences, and the subjects of our research are actually perpetuating what we hope to disrupt? My desire is that this dissertation study elevates the effectiveness of seeking a layered counterstory in the work that we do with communities that are typically overlooked in educational research. A layered counterstory holds science education scholars accountable not only for the methods used to conduct the research, but also the ways science is being defined.

Importantly, I urge the field of science education to center Black girls, in schools, in curriculum, in textbooks, in research methodology, in theory develop. Center Black girls and their imaginations without the goal of changing them or fixing them. Work *with* Black girls. This dissertation asserts that Black girls have ideas that emerge from their liminal perspective, perspectives as adults we have limited access to. We must also develop authentic opportunities to listen to them. We must seek to nurture positive visibility of Black girlhood in all science

learning spaces. As scholars, may we use the privilege entrusted to us to guide others to pause and notice Black girls because they are both beautiful and brilliant.

Appendix A

Program Scope and Sequence

Empowering Girls Through Arts & Science Program Goals

Science

- Be able to name Black women and girls in the histories of science that have contributed to our understandings of the world and be able to talk about those contributions
- Be able to identify historical events that took place in science and articulate how science was used to disenfranchise communities of color
- Be able to explain why science is subjective and identify whose ideas are traditionally privileged when learning science

Girlhood

- Be able to articulate what it means to be beautiful and the importance of self-love.
- Be able to identify the structures and institutions that are in place that influence the experiences of girls.
- Be able to understand the value in having personal time for reflection (which can take various forms i.e., journaling, meditation, art, etc.)

Creativity

- Be able to activate creative capacities to express learning and feelings about the topics discussed.
- Be able to envision a future for girls in science (and in the world) that resists the oppression and disenfranchisement that girls encounter. Be able to think creatively about a future that is beneficial to girls.

EMPOWERING GIRLS

THROUGH ART & SCIENCE

Program Schedule and Curriculum Overview

Program Duration: 2 Weeks (Mon-Fri), July 6-July 17, 2020 2 Hours/Day (20 Hours Total) **Participant Groups** *(up to 12 girls per group)*: • Group A: (Mon-Thurs) 10am-12pm • Group B: (Mon-Thurs) 2pm-4pm • Groups A & B: (Both Fri) 5pm-7pm	**Technology Requirements for Participation**: • Internet access • Computer with web cam and microphone access (Zoom accessible) • Headphones compatible with computer

<u>Empowering Girls Through Arts & Science Program Goals</u>

Science

- Be able to name Black women and girls in the histories of science that have contributed to our understandings of the world and be able to talk about those contributions
- Be able to identify historical events that took place in science and articulate how science was used to disenfranchise communities of color
- Be able to explain why science is subjective and identify whose ideas are traditionally privileged when learning science

Girlhood

- Be able to articulate that there isn't just one way to be a girl, one way to be beautiful, one way to be intelligent, one way to be worthy, and meaningful to the world. Articulate in their own words that beauty starts from within and requires a journey to self-love.
- Be able to identify the structures and institutions that are in place that influence the experiences of girls (Black girls).
- Be able to understand the value in having personal time for reflection (which can take various forms i.e., journaling, meditation, art, etc.)

Creativity

- Be able to activate their creative capacities to express their learning and how they feel about the topics discussed.
- Be able to envision a future for Black girls in science (and in the world) that resists the oppression and disenfranchisement that girls encounter. Be able to think creatively about a future that is beneficial to girls.

Week 1

Mon, July 6	Tues, July 7	Wed, July 8	Thurs, July 9	Fri, July 10
Introductions	Introductions/Ice Breaker	Daily Art Meditation	Daily Art Meditation	Daily Art Meditation
Daily Art Meditation	Daily Art Meditation	Check Ins	Check Ins	Catch Up on Missed Personal Art Expressions
Setting Intentions, Program Logistics, & Final Project	Majority Wins Game* & Discussion Focus Group	From the Past to the Present*	Instagram Intervention Activity	Movie Night: Hidden Figures or The Immortal Life of Henrietta Lacks
Focus Group Q&A	Introduction to **Story-Inspired Basquiat Illustrations**	Introduction to **Adinkra Art and Aboriginal Dot Painting**	Introduction to **Photo Voice**	
Personal Reflection	Personal Reflection	Personal Reflection	Personal Reflection	Personal Reflection
No Personal Art Expression (PAE), explore art package	PAE: Independent Art & Video Diary	PAE: Independent Art & Video Diary	PAE: Independent Art & Video Diary	PAE: Finish up HW that was not finished during the week

**Descriptions of particular activities are explained below.*

Week 1 Activities

Majority Wins - This game is played similar to Black Card Revoked but the questions are designed specifically about the experiences of high school girls. The girls were asked questions and they had to determine which answer best described a high school girl's experience. The girls took turns virtually pulling a card from the deck and the remainder of the girls in the group responded with an answer they thought would be chosen by the majority. Following the game, the girls engaged in discussion about what it means to be a girl and the systemic oppression that Black women and girls encounter due to their various identities.

Past to Present – Together, we explored the ways that Indigenous, Aboriginal, and African peoples used the natural world to make scientific discoveries of their own. We particularly investigated approaches to medicine and how those discovers have informed what we know today.

Instagram Intervention - There are a group of scientists who need our help. They made some amazing accomplishments, but no one really knows about them. They need an Instagram intervention! The girls worked in groups of three to create Instagram profiles for women and girls throughout the history of science. They were responsible for creating the IG handles, bios, the first nine photos on the IG page, and captions for each of them. The goal was to be able to explain the life experiences of the women and girl scientists using an IG page. They presented their IGs to the group. The activity ended with us talking about the photos they chose to post, how hard was it to find information on the scientists, and what about these scientists' lives were we missing because we were only allowed to choose nine photos to represent their lives. This activity ended with a discussion about representation and how the girls chose to represent themselves online.

Week 2

Mon, July 13	Tues, July 14	Wed, July 15	Thurs, July 16	Fri, July 17
Daily Art Meditation	Daily Art Meditation	Daily Art Meditation	Daily Art Meditation	Daily Art Meditation & Video Diary
Check Ins	Check Ins	Check Ins	Check Ins	Catch Up on Missed Personal Art Expressions
Instagram Intervention Discussion	Who Done It? Activity* & Discussion – Is Science Guilty?	Who Done It? Activity* & Discussion – Is Science Guilty?	Program Reflections Black Women in Science Today*	**Virtual Art Showcase** *Parents, families, guardians, friends, program stakeholders are invited*
Introduction to **Self-Portraiture**	Introduction to **Graffiti as Protest**	Introduction to **Comic Books & Children's Books**	Continue working on **Comic Books & Children's Books**	
Personal Reflection	Personal Reflection	Personal Reflection	Personal Reflection	
PAE: Independent Art & Video Diary	PAE: Independent Art & Video Diary	PAE: Independent Art & Video Diary	PAE: Independent Art & Video Diary	

**Descriptions of particular activities are explained below.*

Week 2 Activities

Who Done It? - The girls worked to decide if science was guilty of the harm it has caused to communities of color and for not recognizing the scientific contributions of Black girls and women throughout history. Science was put on trial, and it was up to the girls to decide if science was actually guilty or if the incidents were just some of the few negative effects of the many contributions and advancements science has offered the world. This required acting, research, debate, and scientific argumentation based on evidence. The discussion that followed explored whose science is it anyway. We discussed the benefits and pitfalls of science and explored how science was taught in school compared to what we are learning.

Black Women in Science Today – Black women who were working in the various fields of science joined our virtual session. They sat on a small panel and shared about the work that they do and shared their opinions of what they believe the experience is like for women in STEM today.

Appendix B
Artistic Expression Prompts

Personal Art Expression 1: Jean Michel Basquiat Inspired Illustrations

*For your first personal art expression you will be creating **Basquiat Illustrations.** Use the prompt below to guide your art. Submit a quality photograph that is on a flat surface with good lighting. Use a cellphone or computer camera and upload. DO NOT USE your new Fujifilm Instax Camera.*

Prompt: In our Empowering Girls session today, we discussed what it means to be a teenage girl in the world right now. We played a game where you had to determine which answer best describes a high school girl's experience.

Using what we talk about today, create at least 2 (make as many as you'd like) Basquiat inspired illustrations that capture how you feel about being a teenage girl in the world today, considering all your life experiences, friendships, family, school, social media, self-esteem, etc.

Submit a photo of your completed art to this assignment, below.

Materials *(use the materials you prefer)*:

- White card stock paper
- Markers
- Oil Pastels
- Crayons
- Watercolors

Video Diary 1: Basquiat Illustrations

Submit a video of you reflecting on the Basquiat inspired art you created. Show your art in the video. Describe some of the artistic decisions you made. Describe how you felt making the art. Just reflect. Use the questions below to guide your reflections.

Record your video using a cellphone or computer camera and upload to this assignment, below. Please save your video as an mp3 or mp4.

Questions:

1. Did you enjoy making this art? Please explain why or why not.
2. How does your art represent how you feel about being a teenage girl, today? What is the meaning of the art you created?

3. What does your art have to do with the topics discussed in today's Empowering girls' session?

Personal Art Expression 2: Adinkra and Aboriginal Dot Painting

*For your next personal art expression, you will be creating your own rendition of **Adinkra art** and **Aboriginal Dot Painting.** Use the prompt below to guide your art. Submit a quality photograph of the art you create. Make sure it is on a flat surface with good lighting. Use a cellphone or computer camera and upload. DO NOT USE your new Fujifilm Instax Camera.*

Prompt: In our Empowering Girls session today, we discussed how people of the past have explored the natural world, created new ideas, and inspired what we know about the world today. People have been making "scientific" discoveries for centuries. Specifically, people of color and Black people have been curing illnesses with items that can be found in nature and have been using complicated mathematics to build amazing wonders.

Using what we talked about today, create ONE piece of art.

1. **If you choose to create Adinkra art: Using the appropriate symbols (be sure to look up their meanings) create a pattern that tells the story of one group of people you learned about today and their understanding of the world.**
2. **If you choose to create Aboriginal Dot Painting. Using dots and/or lines, tell a story that represents another discovery you learned about today.**

Submit a photo of your completed art to this assignment. Click "Submit Assignment"

Materials *(use the materials you prefer)*:

Adinkra Art

- White card stock paper
- Markers
- Oil Pastels

Aboriginal Dot Painting

- White card stock paper
- Acrylic Paint

Video Diary 2: Adinkra and Aboriginal Dot Painting

Submit a video of you reflecting on the Adinkra and Aboriginal Dot Painting renditions that you created. Show your art in the video. Describe some of the artistic decisions you made. Describe how you felt making the art. Just reflect. Use the questions below to guide your reflections.

Record your video using a cellphone or computer camera and upload to this assignment, below. Please save your video as an mp3 or mp4.

Questions:

1. Did you enjoy making this art? Please explain why or why not.
2. How does your art represent how you feel about the histories we learned today? What is the meaning of the art you created?
3. What does your art have to do with the topics discussed in today's Empowering girls' session?

Personal Art Expression 3: Photovoice

For your next personal art expression, you will be using Photovoice. Use the prompt below to guide your art. Submit a quality photograph that is on a flat surface with good lighting. Use a cellphone or computer camera and upload. DO USE your new Fujifilm Instax Camera.

Prompt: In our Empowering Girls session today, we talked about the use of photographs to tell a story and to capture moments in time. We talked about the affordances and the limitations to the use of photographs. We used photographs to highlight some key moments in the lives of Black women who have contributed to science that we may have never heard about.

Using photovoice, capture total of 5 THINGS that you are proud of (in your home, community, something you've created, etc.) OR that bring you joy.

Submit a photo of your collection of photos to this assignment, below.

Materials *(use the materials you prefer)*:

- Fujifilm Camera
- Markers (To decorate the borders of your photos)

Video Diary 3: Photovoice

Submit a video of you reflecting on the photos you took inspired by the method, photovoice. Show your photos in the video. Describe some of the artistic decisions you made with your photos. Describe how you felt taking the photos and reviewing them. Talk about what you chose to photograph. Just reflect. Use the questions below to guide your reflections.

Record your video using a cellphone or computer camera and upload to this assignment, below. Please save your video as an mp3 or mp4.

Questions:

1. Did you enjoy making this art? Please explain why or why not.
2. How does your art represent how you feel about the use of photographs to tell a story? What is the meaning of the photos you took?

3. What does your art have to do with the topics discussed in today's Empowering girls' session?

Personal Art Expression 4: Self-Portraiture

For your next personal art expression, you will be creating a self-portrait. Use the prompt below to guide your art. Submit a quality photograph of the art you create. Make sure your art is on a flat surface with good lighting. Use a cellphone or computer camera and upload this. DO NOT USE your new Fujifilm Instax Camera to take a picture of the art.

Prompt: In our Empowering Girls session today, we talked about the strengths and limitations of using photos to represent one's life during our Instagram Intervention activity. We used photographs to highlight some key moments in the lives of Black women who have contributed to science that we may have never heard about.

Today, you will personally create a picture of yourself using self-portraiture. It's up to you how you would like to present yourself in this form of art. Your self-portrait can be as naturalistic or abstract as you want it to be. Your art could just be a representation of all the things that make you who you are and not a face at all. That is up to you! For this personal art expression, you will be creating a portrait of yourself.

Submit a photograph of the self-portrait you create by clicking "submit assignment."

Materials *(use the materials you prefer)*:

- Be creative! Whatever materials you'd prefer.

Video Diary 4: Self-Portraiture

Submit a video of you reflecting on the self-portrait you've create. Describe some of the artistic decisions you made. Describe how you felt making a portrait of yourself and what you wanted to make sure you included. Just reflect. Use the questions below to guide your reflections.

Record your video using a cellphone or computer camera and upload to this assignment, below. Please save your video as an mp3 or mp4.

Questions:

1. Did you enjoy making this art? Please explain why or why not.
2. How does your art represent who you are? Explain what you have drawn and what it means to you?

Personal Art Expression 5: Graffiti as Protest

For your next personal art expression, you will be creating graffiti as a form of protest. Use the prompt below to guide your art. Submit a quality photograph of the art you create. Make sure your art is on a flat surface with good lighting. Use a cellphone or computer camera and upload this. DO NOT USE your new Fujifilm Instax Camera to take a picture of the art.

Prompt: In our Empowering Girls session today, we began exploring the ethics involved with scientific exploration. You were tasked to consider who was responsible for the hurt caused to certain communities of color. Is science the one to blame? Whether it was the Tuskegee Syphilis Experiment, the story of Henrietta Lacks, Eugenics, or the sterilization of Black women, you learned about some moments in history that were harmful and unfair to the people who experienced them (and still do).

Think about some of the topics we talked about today. Use the art form of graffiti to stand up for what is right and share your opinion! What would you write or draw on the side of a building in support of a group of people explored today? What would you say or draw demanding justice for the harm caused to these people?

Submit a photograph of the art you create by clicking "submit assignment."

Materials *(use the materials you prefer)*:

- Sketch paper (white paper)
- Markers
- Crayons
- Oil Pastels
- Watercolors

Video Diary 5: Graffiti as Protest

Submit a video of you reflecting on the graffiti art you made, today. Show your art in the video. Describe some of the artistic decisions you made and explain why you made them. Describe how you felt making the graffiti and the statement you are making. Just reflect. Use the questions below to guide your reflections.

Record your video using a cellphone or computer camera and upload to this assignment, below. Please save your video as an mp3 or mp4.

Questions:

1. Did you enjoy making this art? Please explain why or why not.
2. How does your art represent how you feel about the stories we talk about today? What is the meaning of the art you created?
3. What does it mean to protest and how are you using your art as a form of protest?

Personal Art Expression 6: Comic Strip or Children's Book

For your next personal art expression, you will be creating a comic strip or a short children's book imagining girls in the future. Use the prompt below to guide your art. Submit quality photographs of the art you create. Make sure your art is on a flat surface with good lighting. Use a cellphone or computer camera and upload this. DO NOT USE your new Fujifilm Instax Camera to take pictures of your art.

Prompt: In Empowering Girls we have been discussing a lot of topics. Mainly, we have been highlighting moments in the history of science that are traditionally not explored in school. We have looked at the accomplishments of communities of color and Black women, particularly. We explored some ways that people have been harmed in the name of science. Now, you will use this knowledge to imagine a new, bright future for girls.

Close your eyes. If you could imagine a future world with no limitation, what would that world look like? How would you push back on racial, gendered, and economic discrimination?

Create a short comic strip **or** children's book that centers a girl (or multiple girls) in the future. It's the future and it's your imagination, so you get to decide what's possible. Be creative! Feel free to use some of the art techniques you have already done (ex. Basquiat illustrations, dot painting, adinkra, portraiture, abstract art, etc.).

Submit photographs of the art you create by clicking "submit assignment."

Materials:

- Little White Book (or any other means)
- Any materials you prefer

Video Diary 6: Comic Strip or Children's Book

Submit a video of you reflecting on the comic strip or children's book you made, today. Show your art in the video. Describe some of the artistic decisions you made and explain why you made them. Describe how you felt making the comic strip or children's book. Just reflect. Use the questions below to guide your reflections.

Record your video using a cellphone or computer camera and upload to this assignment, below. Please save your video as an mp3 or mp4.

Questions:

1. Did you enjoy making this art? Please explain why or why not.
2. Based on your imagination, explain what you imagine the future to be like. In your art how has the world changed? What remained the same?
3. In what ways do the topics we've discussed in the program influence what you have created?

Appendix C

Program Flyer

Appendix D
Program Application

Empowering Girls Through Art & Science Application

Hello there,

Thank you for your interest in Empowering Girls Through Art & Science! My name is Amber C. Davis and I am a former high school chemistry and forensic science teacher, and currently a doctoral student at the University of Michigan studying science education. My passion for women and girl empowerment, teaching and mentorship, and science learning has led me to design this program for girls, which I hope the high school-aged girl in your life is interested in participating.

During this 10-day empowerment program (July 6-17), we will engage in activities where girls can unpack the highs and lows of their experiences as teenagers in the world today and develop strategies to overcome the pressures of social media, building positive friendships, and taking care of their personal mental health. We will also engage in scientific inquiry that prioritizes how Black and Brown women and girls have contributed to the fields of science, historically and globally.

To successfully apply, complete the following application questions, provide thoughtful and proofread answers to the three essay questions, and sign and submit the Participant Assent Form. This program will also serve as the site for my dissertation research study. If accepted to Empowering Girls Through Art & Science, scholars are asked to also participate in my research study. More information regarding the details of my research study can be found in the Participant Assent Form, which will be sent to you via email once you submit this application. I am also available via email to answer any questions. Please email your consent form, signed by both the participant and a parent/guardian, to the email below.

I am looking forward to building community, being creative, and exploring science together!

Amber C. Davis
acsize@umich.edu

acsize@umich.edu Switch account

* Required

Email *

Your email

1. Applicant's FIRST Name *

Your answer

2. Applicant's LAST Name *

Your answer

3. Please indicate your gender. *

Your answer

3. What is your race/ethnicity? *

- ○ American Indian/Native American
- ○ Asian or Pacific Islander
- ○ Black/African American
- ○ Hispanic/Latinx
- ○ White/Caucasian
- ○ Other:

4. How old are you? *

Your answer

5. What grade will you be in during the 2020-2021 academic year? *

- 9th Grade
- 10th Grade
- 11th Grade
- 12th Grade
- Other:

6. What school will you be attending during the 2020-2021 academic year? *

Your answer

7. Please check all of the science courses you have previously taken in high school? If the courses you have taken are not listed below, please add them. *

- [ ] Physical Science
- [ ] Environmental Science
- [ ] Biology
- [ ] Earth Science
- [ ] Conceptual Physics
- [ ] Physics
- [ ] Chemistry
- [ ] Anatomy
- [ ] Other:

8. Please check all of the science courses you plan to take during the 2020-2021 academic year? If the course(s) you plan to take are not listed below, please add them. *

- [ ] Physical Science
- [ ] Environmental Science
- [ ] Biology
- [ ] Earth Science
- [ ] Conceptual Physics
- [ ] Physics
- [ ] Chemistry
- [ ] Anatomy
- [ ] Other:

9. How would you describe yourself to someone who is meeting you for the first time? What would you consider to be your strengths and what are some of your areas of growth? What do you enjoy doing and what makes you happy? **Your response to this question should contain 150-300 words. *

Your answer

10. Please honestly explain your previous experiences with science (in school and outside of school). What do you like most about science OR what is challenging about science? Do you engage in science outside of school? If so, in what ways? If not, please explain why. *

Your answer

11. Please explain why you would like to participate in this empowerment program. What do you hope to gain as a result of your participation? **Your response to this question should contain 150-300 words. *

Your answer

12. If selected to participate in this program, can you commit to attending ALL ten days of programming? (July 6-July 17) *

- ◯ Yes
- ◯ No

A copy of your responses will be emailed to the address you provided.

Appendix E
Focus Group Protocol

INTERVIEW PROTOCOL
Script

I am so excited that I get to meet with such a diverse and brilliant group of girls/young women virtually and talk about your experiences and how you see the world. This focus group is a part of my research study, which you are a part of by being a part of Empowering Girls Through Art & Science, but it is also a great initial setting for us to get to know each other, identify some similarities and differences that we have with one another and begin to build trust and community with one another. I'm hoping that this program is meaningful and useful to you, and I also hope that the wonderful information that comes from this program shows those who do research in education that not all girls are alike, that girls are extremely intelligent, and that girls should be asked about ways to make school, learning, and specifically science learning more useful to them. I value your opinion, your experiences, and I trust that you are experts on your own lives. Thank you for participating in my study, I do truly appreciate y'all!

This is a focus group, which is somewhat different than a traditional interview. What makes it different is that there are more than two people participating in the interview at one time. Traditionally, an interview consists of two people, the person asking the questions and the person answering them. Here, we are all engaging in a discussion together, where we can build on one another's ideas, ask questions, change our minds about what we previously said, agree and disagree. I have a set of questions here to guide our discussion, but let's keep it open to allow for us all to offer questions if they arise. Does that sound okay?

To insure I am able to remember the discussion that we have, I will be video and audio recording our time together here on Zoom. When I am recording, you will see a flashing red dot in the corner of your screen. The information that is shared here, will be used in my study, but I will insure to maintain your confidentiality and not share anything you say that can be used to identify who you are. Each of you has chosen a pseudonym that you would like used to refer to you in my research study and they are used as the names on Zoom accounts for this study. During our discussion today, please refer to yourself and one another using your pseudonym to maintain your anonymity. What is also particularly important is that the information shared during this focus group is confidential information and should not be discussed outside of the focus group. In your assent form, completed after your program application, you agreed to be video and audio recorded, but if you no longer feel comfortable being recorded, please let me know. Is there anyone who would prefer to not be video or audio recorded today?

Lastly, if there are any questions you choose not to answer or at any point would like to remove yourself from the group, please let me know. That's no problem! The focus group will take about 45min to an hour. Do you all have any question before we jump in?

FOCUS GROUP QUESTIONS

Questions will be on a slide that I will share with participants using the "share screen" feature.

1. I'll give you a minute to think about this but think of THREE words that you think **others** would use to describe you. Be ready to share and explain why you think they may use those words.
2. Now, think of THREE words that you would use to describe yourself and be prepared to share why you think these words are similar and/or different than the way others would describe you.
3. What does it mean to be a Black girl in society today?
    a. How does being a Black girl make you feel?
    b. What do you think is the best part about being a Black girl in society today?
    c. What is the most challenging about being a Black girl?
4. Who do you consider to be a role model (they don't have to be Black girls or women)? Why would you consider them to be role models?
5. Do you agree or disagree with this statement? All Black girls and women are beautiful. Why or why not?
    a. How are you defining beauty?
6. When was the last time you did something creative? What was it? How did it make you feel?
7. Would you consider yourself to be creative? Why or why not?
    a. What does it mean to be creative?
8. What is something you like to do that brings you joy and makes you happy?
9. How would you rate your current group of friends?
    a. Super positive & supportive (we are on the same wavelength) ...Not so positive and not supportive of my goals
10. How do you make it through hard times or challenging times? What do you do to keep going?

Okay, now we are going to transition into how you feel about science and being a girl in science.

11. Tell me how you feel about science? What are your initial thoughts and feelings when I say "science"? What does it make you think of?
    a. Do you like science? Dislike science? Why?
12. What about the high school science class you are currently taking? How do you feel in that class?
13. Can you think of an example (or multiple examples) of Black women and girls in science?
    a. Where and when did you learn about this?
14. In science, do you think it matters who you are? Your race, gender, socioeconomic status? Why or why not?

This is the last question.

15. As we continue in this program, what are some topics or questions you would like to talk about? There will also be a "safe box" that you can write down thoughts and questions in if you prefer to share anonymously.

Appendix F
Semi-structured Interview Guide

Interview Questions

1. What are THREE words you would use to describe yourself as of today? Why did you choose those three words?
2. What does it mean to be a Black girl in society today?
    a. How does being a Black girl make you feel?
    b. What do you think is the best part about being a Black girl in society today?
    c. What is the most challenging about being a Black girl?
3. Do you agree or disagree with this statement? All Black girls and women are beautiful. Why or why not?
    a. How are you defining beauty?
4. Would you consider yourself to be creative? Why or why not?
    a. What does it mean to be creative?
5. Please be honest, if anything, what have you learned during this program?
6. What is something you want to be sure to remember after this program is over?
7. Which day or activity in Empowering Girls Through Art & Science was the most enjoyable to you? Why is that?
8. Which day or activity in Empowering Girls Through Art & Science did you enjoy the least? Why is that? You can be honest. It won't hurt my feelings.
9. When you think about science, what comes to mind?
    a. Is this different or similar to the way you thought about science before our program?
10. In science, do you think it matters who you are? Your race, gender, socioeconomic status? Why or why not?
11. Do you want to pursue a career in science (or engineering), why or why not?
    a. What are some possible career options that you may consider whether science related or not?
12. What would you like others to know about Empowering Girls Through Art & Science? Would you recommend other girls to participate? Why or why not?

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