Chapter 8
The Journey of Decolonization as a Scientist and Science Education Researcher

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> Decolonization is an emotional process; not in the simplistic way ascribed to non-white peoples by white supremacy, but in a way that goes beyond, goes deeper, goes further than reason can reach (Sium et al., 2012, V).

As I reflected on my trajectory in becoming a biologist, I came to understand the processes and experiences that informed how I defined and conceptualized what it meant to engage in scientific practices and become an authentic member of the science community. Since elementary school, science has always been one of my favorite subjects. I was fascinated with the systems, structures, patterns, and cycles found in science content. My attempts to learn big words, ideas, concepts and follow detailed processes continued through high school and undergrad. Participating in lab activities accounted for some of my most memorable and enjoyable experiences during high school and college. I fondly remember the opportunities to wear safety goggles and white lab coats, to carefully mix chemicals, to meticulously work on lab benches and analyzing science conference posters that were on the walls and hallways throughout the lab. All these elements were instrumental in my learning and development of a strong science identity. Despite my unwavering love for science and desire to become a scientist, it became evident that the practice of memorizing vocabulary words emerged as an essential skill for achieving academic success in these contexts. Even during my experiences of pursuing a Masters of Science in Biology, memorizing and reproducing the content for the test was the most efficient way of being successful. Additionally, my undergraduate and

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graduate courses, labs thesis advisor, graduate program supervisor were mostly led by white male professors which stood out to me as a Black female student. I took note that in higher education spaces, I had four female science professors, and only one was a woman of color. I spent more than 5 years in undergraduate and graduate science spaces learning content, practices, ways of thinking, evaluation, and skills from a majority of white men. These were the people evaluating my understanding of science concepts through tests and quizzes. They expressed their understanding of who a scientist is and what a scientist does through the way they ran their labs and over time, that way was what I also emulated. I earned a job after college as a medical testing scientist during the height of the Zika and Ebola virus outbreaks. The difference between that lab and my educational experiences was that instead of the team being predominantly white and male, there were four white female scientists. Although new protocols and procedures were unfolding, we mainly worked individually and siloed without socializing beyond birthday celebrations in the kitchen area. However, after experiencing science learning and skills up to that point, I had learned to do my best to fit in. Often being the only Black person in a lab, I knew how to assimilate into the science spaces. Some assimilative practices and performances in this context ranged from feeling the pressure to always be fluent in science vocabulary, not asking questions too often in order to seem full of information, consciously representing Black people since I was the only Black person in the lab, and paying close attention my physical appearances, especially that of my hair. I often changed the style of my natural hair which historically for Black women has been associated with gender, class, and beauty. In the testing lab, wearing my hair straight or in a braided style was the talk of the lab for days which one time included the comment "I like your hair straight. Seems more professional." How were my curls less professional? Why would my hair be of concern when I do not use hair in my work? Yet, my co-workers made audible comments to me and each other about my hair. To avoid being the focus of group conversation, I refrained from certain hair styles which included continuing to straighten my hair. Eventually, I came to understand science and self-expression in science spaces was something afforded to white people, especially white men. Lab spaces were only for calculated discovery. The physical materials such as glassware, chemical ingredients, goggles, and white coats were used in science labs and only by scientists. Science was serious work exclusive to a certain group of people that had earned their place in the space. From these years of training, I understood that becoming a practicing scientist meant that I did not always use the words and phrasing I did with my friends and family. I also learned that academic assessments were the main evaluation method of knowledge and understanding. Memorization skills, in particular, ensured me a high score on standardized assessments. Other forms of assessment such as projects beyond a lab notebook, storytelling, or a narrative format were not used in science spaces. I also learned that in the lab setting, expressing myself through my hairstyles was also out of the question or else I became the focus of the few lab conversations that included my hair's level of professionalism. I learned how to maneuver these science spaces by talking differently, using certain words, memorizing content, and lowering my self-expression to stay in the spaces with the least friction. Assimilating into the

existing cultures was the way I survived in the lab space. I slowly yielded to the pressures that existed for me there. My experiences with science were colonized to the point I no longer was able to separate myself from the limiting and restricting ways of learning and being that mostly benefited white men. When approaching my dissertation study and considering the design of science curriculum to be taught to secondary level students, I wanted one that could be more applicable to daily scenarios and reflective of cultural practices. But how was I to do that when I had not experienced it? Centering a science curriculum around Black hair care required a decolonizing of my own understanding and practices of science. That process was not easy.

8.1 Decolonization as a Theory

Radical processes for liberation through decolonized curriculum and assessment strategies are supportive for those experiencing oppression due to colonization and racism. New "tools" for decolonization within science education are required "for the master's tools will never dismantle the master's house" (Lorde, 1997, p. 5). Sium et al. (2012) posit decolonization as a "rearticulation" of power by not recreating a similar system with the stratification of marginalized or oppressed groups (p. III). Decolonization is a theory and dynamic process that focuses on expansion by including and integrating more values than the dominant one (Tavernaro-Haidarian, 2019); thus, requiring it to be intentional as much as it is critical and anti-racist in theory (Tuck & Yang, 2012). Battiste (2014) and Higgins (2016) argue for a two-step process of decolonization: (1) deconstructing structures that are oppressive to minoritized groups and (2) restructuring of experiences through centering culturally sensitive ways-of-knowing (see Fig. 8.1). As such, we are following Crenshaw (1991) and will be capitalizing *Black* as a proper noun referring to a specific cultural group and not *white* since it does not reference a specific cultural group throughout this chapter.

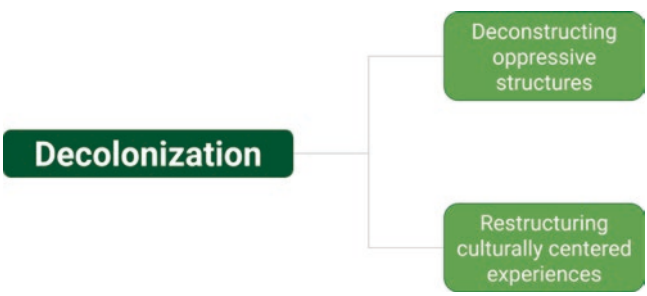

Fig. 8.1 Decolonization as a two-step process of deconstructing oppressive structures and restructuring culturally-centered experiences. (Battiste, 2014; Higgins, 2016)

8.1.1 Decolonization as Praxis

In order to bring to fruition a science experience for Black girls that was asset-based and incorporated knowledge and cultural expertise through the engagement in science practices, the first author with the guidance of the second author developed a curriculum with assessments that were culturally derived and centered. A primary goal of the curriculum was to push against the normalization of Whiteness in science education by centering on Black hair and hair care product making. Ashley and Brown (2015) suggest that for Black women and girls "hair care can provide a context and vehicle for attachment, nurturing, and positive self-worth" (p. 1). Overtime for Black women, a '[Hair] style could lead to acceptance or rejection from certain groups and social classes, and its styling could provide the possibility of a career" (Rooks, 1996, p. 5–6).

For many, natural hair was considered a problem to be fixed by straightening, since straightened or relaxed hair allowed a Black woman to seemingly appear more professional, attractive, and ultimately closer to Whiteness (Mercer, 2005; Okazawa-Rey et al., 1987; Thompson, 2008). "Hair acts as a figurative and corporeal stage for analyzing how Blackness, gender, class, and beauty are performed, in essence, 'done'" (Jacobs-Huey, 2006, p. 87). By removing natural curls, coils, and kinks, Black women were able to remove culturally identifying markers to gain access to employment, decrease discrimination in social settings, define the beauty standard through modeling, and gain acceptance into predominantly White spaces (Ford, 2015; Mbilishaka, 2018; Rooks, 1996; Thompson, 2008). This phenomenon explains the attachment and nurturing many Black women and girls experience with their hair care practices. However, the way culture and activity systems impact learning have not been sufficiently studied or researched (Bang, 2015).

In this chapter, we present the process the first author took to explore and understand what it meant for a self-identified Black woman scientist to design and implement a science curriculum and inquiries that highlighted Black hair and skin care. Using a critical autoethnography methodology, this research investigates the question: *what is the process a self-identified Black woman scientist took in order to design and implement a science curriculum that highlighted Black hair and skin care*? The inclusion and representation of Black girls within science curriculum challenges settled hierarchies, irrelevance, and disinterest within STEM experiences. However, through the application of decolonization beyond a theory required more than the two-step process of identifying and restructuring. The explicit and intentional disruption to settled hierarchies within science education through decolonization has led to this project not being readily published as of yet. It is our hope that sharing the intimate experience decolonizing one's own practice will support researchers, curriculum developers, editors and other publishers to be introspective if they apply such critical frameworks.

8.2 Theoretical Framework

Hierarchies within science education are a result of the influence of Whiteness through colonization and the concretizing of Whiteness as a "culture of power" (Aschbacher et al., 2010, p. 564) through curriculum, instruction, and assessment. Here, Whiteness is defined as "the production and reproduction of dominance rather than subordination, normativity rather than marginality, and privilege rather than disadvantage" (Frankenberg, 1993, p. 236). Overall, Whiteness is more than how people see themselves; rather, Whiteness is a product of dominance, subordination, and privilege. The identification and naming of colonized, settled, and oppressive norms and practices within education have been presented through various works. For example, there has been much critique of the use of data that problematizes the achievement gap (Gutiérrez, 2008) between Black and white students without considering the racial biases that exist within assessment instruments. Another example is the assimilation and lack of cultural diversity necessary to be recognized as thinking or behaving like a scientist (Aikenhead & Elliott, 2010). The presumption that there is a very narrow expression of science thinking and doing is a result of Whiteness being atomized in the structure of science as a discipline (Mensah & Jackson, 2018). These "traditional" ways are examples of how science experiences have othered and marginalized the intersectional experiences of Black girls. The first author was not exempt from internalizing and acting on these science traditions that were altogether harmful and restricting during her journey as a scientist. Yet, separating herself from these ideals led to deep grief due to the loss of attachment to colonizing science. In the next sections, we define a science attachment then expand on attachment theory and loss as the theoretical framework.

8.2.1 Attachment Theory and Loss

Psychologist J. Bowlby details attachment theories and loss of attachment through analyzing systems of behavior. Bowlby (1980) suggests that "feedback, continuous account is taken of any discrepancies there may be between initial instruction and current performance so that behavior becomes modified accordingly. Attachment behavior has become a characteristic...because it contributes to the individual's survival..." (p. 39–40). Black girls in STEM at times experience othering and separation (Keller, 1985), erasure (Tobin et al., 1999), disinterest (Roth & Lee, 2004), isolation (Rosa & Mensah, 2016), and irrelevance (Herzig, 2010; Ireland et al., 2018). In the introductory vignette, the first author recalled instances where assimilation to the white male-led science spaces experienced through usage of scientific vocabulary and acutely being aware of hairstyles was for her overall benefit in science spaces to combat othering, isolation, and irrelevance. In agreement with, it is these settled hierarchies that "can profoundly shape who and what is seen and heard as scientifically meaningful" (Rosebery et al., 2016, p. 1573).

Over time, behaviors such as, promoted individuality, vocabulary recall, usage of science terminology, and lack of self-expression were no longer choices for participation but based on feedback necessary for survival in said science spaces and to be recognized as thinking or behaving like a scientist (Aikenhead & Elliott, 2010). These actions were part of the first author's success in science spaces through research labs, testing labs, and college science labs although none of the science experiences were reflective or inclusive of Black and/or female scientists. These norms were internalized leading to the specific attachment to colonized science; therefore, making the process of developing and implementing a decolonized science curriculum extremely difficult. She found herself dealing with the loss of familiar, colonized ways of understanding in order to develop and implement decolonized science activities and expanded assessment modalities.

In order to create such a curriculum, the first author had to participate in a deep, personal process of unlearning and detaching from 10 years of traditional training, teaching, and research as a biological scientist. Designing and implementing an asset-focused, culturally-based decolonized curriculum without a template or precedent, required intentional design for disruption of settled hierarchies within science education. Further exploring the oppressive powers of race, gender, and class on the Black women "shed new light on how domination is organized (Collins, 2000, p. 227), including science education.

Preparing to develop a decolonized science curriculum and assessment meant to apply the two-step process (1) deconstructing structures of oppression and (2) restructuring experiences through centering culture. However, what was discovered through the process of decolonization was a third step of grief due to the separation from the attachment of colonized science. Bowlby et al. (1989) highlight four stages of grief associated with the loss of attachment: (1) numbness, (2) yearning and searching, (3) disorganisation and despair, and (4) reorganisation (see Fig. 8.2). Decolonization required separating the attachment to the traditional training in

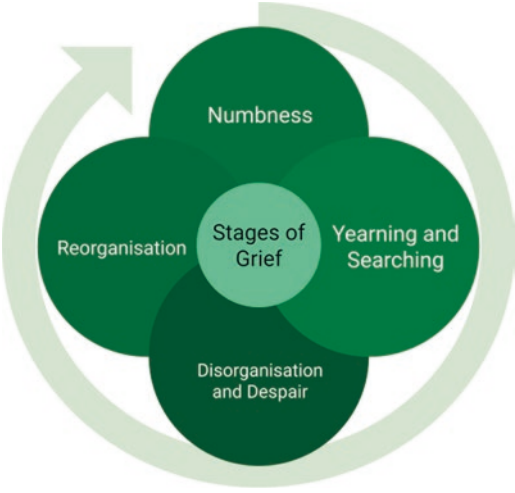

Fig. 8.2 The four stages of grief associated with the loss of attachment as a cycle of numbness, yearning and searching, disorganisation and despair, reorganisation. (Bowlby et al., 1989)

order to fully deconstruct and identify structures of oppression within science and center culture through science curriculum. In the next section, we present the methodology used to investigate this journey of decolonization for a Black female scientist experienced.

8.3 Methods

In this section, we outline critical ethnography as the methodology for investigating the ways a Black female scientist approached developing and implementing a decolonized science curriculum. Using this methodology, we answered the question "*what is the process a self-identified Black woman scientist took in order to design and implement a science curriculum that highlighted Black hair and skin care*?' This section concludes with the curriculum that was developed and how it was implemented.

8.3.1 Critical Autoethnography Methodology

To present this complex journey, we use critical autoethnography methodology that combines ethnography, autobiography, and critical pedagogy. We chose this qualitative method to allow for the examination of self, systematically and transparently, while considering and challenging dominant social realities (Boylorn & Orbe, 2014; Ellis & Bochner, 2003; Hughes & Willink, 2015). The first author identifies as a Black woman who is part of a marginalized and minoritized population within science, technology, engineering, and mathematics (STEM) (Tan et al., 2013). In particular to STEM, these matrices have been conceptualized as the double-bind (Ong et al., 2011), where women of color experience matrices of domination within STEM workplaces and educational settings because of perpetuated Whiteness (Morton & Parsons, 2018).

Moreover, we chose to implement a methodology that considers the impacts of historically and perpetuated norms with intersectional identities like a Black woman within the field. "The intersection of racism and sexism factors into Black women's lives in ways that cannot be captured wholly by looking at the race or gender dimensions of those experiences separately" (Crenshaw, 1991, p. 1244). Black girls have experiences at distinct intersections that have impacted their interest and persistence in these STEM disciplines (Johnson et al., 2011; Ong et al., 2011). Through a critical autoethnography, we highlighted "the world of educational research in ways that go unnoticed" (Marshall & Barritt, 1990, p. 594) such as the racial and gendered experiences of the first author, a Black female scientist and science educator. Since colonization results in the dehumanizing and erasing cultural norms and identifying characteristics, decolonization requires the centralizing and celebration of culture.

8.3.2 The Design of the Lotions and Potions Curriculum

Lotions and Potions: Science through Hair Care is a culturally sustaining science curriculum that foregrounded cultural elements of Black hair care product making as the object of scientific inquiry and exploration using the foundational framework of decolonization. The focused interaction of this curriculum was for students to investigate skin and Black hair as science content and use the making hair care products to participate in science and engineering practices (NGSS Lead States, 2013). Each lesson had a packet with science content explanations, materials lists, instructions to make a product, journaling section, and activity pages for a total of 67 pages (see Fig. 8.3). The content, figures, and models for the curriculum were referenced from *The Science of Black Hair* by Audrey Davis-Sivasothy (2011). The hands-on activities and Do-It-Yourself (DIY) products were designed to have the students directly engage with the making process and participate in science and engineering practices. The lessons in the "Lotions and Potions: Science through Hair Care" curriculum followed a framework of disciplinary core idea, hands-on activity, and assessment of science and engineering practices (see Table 8.1). The formative assessment in Lesson 1 were the observations the students took of the learning lab. Lesson 2 was focused on the layers of skin, organs in the skin, and hair as a human product. The materials and instructions provided in Lesson 2 for the hands-on activity were to familiarize students with the template of making activities and the presentation of materials and steps. Additionally, this lesson also introduced the concept of hair patterns and how to identify various types of hair patterns to highlight the science and engineering practice of developing and using a model. The formative assessment in this lesson afforded students to make observations about hair patterns and the

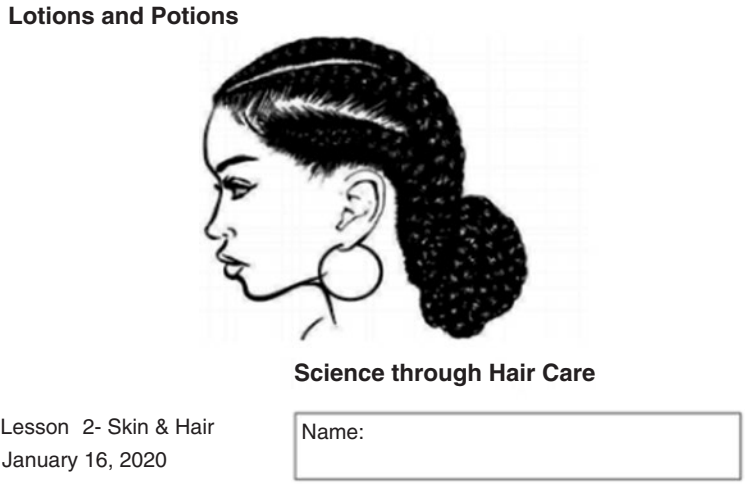

Fig. 8.3 Image from the front of the packets that students received each lesson with "Lotions and Potions"

Table 8.1 Outline of the "Lotions and Potions: Science through Hair Care" curriculum

Lesson	Hands-on activity/DIY product	Science and engineering practice	Formative assessment
Lesson 1: Introduction	"Around the room observations"	Obtaining, evaluating, communicating information	Observation statements
Lesson 2: Skin and hair	"Skin elasticity"	Obtaining, evaluating, communicating information	Observation statements
		Developing and using a model	Hair pattern modeling
Lesson 3: Soap	"How soap works"	Using a model	Fill-in the blank
		Using a model	Label the diagram
		Using a model	Label the hair pattern
Lesson 4: Lotion	Hair lotion	Constructing explanations	Matching
Lesson 5: Hair oil	Hair oil	Engaging in argument from evidence	Pair-share activity
Lesson 6: DIY video	DIY video	Engaging in argument from evidence	DIY video

opportunity to develop models of their hair pattern. The formative assessments in Lesson 3 were fill-in-the blank, label the diagram, and label the hair pattern which required the students to participate in using hair and skin models available in the room. Lesson 4's formative assessment was a matching activity to scaffold scientific argumentation before the students made their second DIY product, lotion. Scientific argumentation was one of the science practices that was highlighted as a trajectory guided by the curriculum and explored further in a later chapter. The content area for Lesson 5 was moisture for the hair strand using hair oil. The students began the class with a pair-share activity as a formative assessment. The students had completed two of the three product making classes and three out of four classes with new content. Rather than situate the "think" alone then pair into groups, students worked together to address one of three prompts then share with the class. Lastly, Lesson 6 was focused on producing the DIY video as the formative assessment. The students were given the option to choose from a list of topics and products to present in their DIY video. The DIY video served in the curriculum for the trajectory of scientific argumentation which is analyzed in a later chapter.

Although the results of this intervention provided insight into the ways middle school Black girls engaged in science and engineering practices through a hair care curriculum, the development of the curriculum brought a large shift in thinking about curriculum for the first author. In an effort to decolonize science experiences, the packets featured coloring pages of Black girls served as a mirror of representation (Bishop, 2012) and relevance within curriculum (Banks & Banks, 2004; Quiroz, 2001). Additionally, addressing individualism through collaborative efforts among STEM spaces would directly address the isolation that affects perseverance of Black girls and women in STEM (Ireland et al., 2018; Rosa & Mensah, 2016). Additionally, these images were to directly combat Eurocentrism that is reproduced in science

materials and resources (Higgins, 2016). To decolonize science experiences around isolation, students worked in groups of two throughout the lessons. Lastly, the first author focused on students seeing one another as sources of knowledge rather than just the worksheets or the teacher. Following Engle and Conant (2002), students engaged in sense-making through (a) identifying a question or problem (b) taking authority in approaching the problem, (c) approaching a solution and reason collaboratively, and (d) were supported in resources like the teacher, worksheets, and internet access.

8.3.3 Participants and Context

The implementation of the curriculum, "Lotions and Potions: Science through Hair Care" after-school class, ran for six classes, twice a week for 90 minutes each class, totaling 17 plus hours of contact time in January 2020. The site of this research took place in an interdisciplinary lab at a private university in Philadelphia's (PA) urban center. Ten, Black middle school girls in grades five through seven, ages 10–13, were recruited through a flyer distributed to several local after-school programs. The inclusion criteria for this project were enrollment in middle school and to self-identify as a Black girl.

8.3.4 Reflexivity

Following King and Pringle (2019), the first author positioned herself through this work as a researcher, curriculum developer, and class facilitator. Through intentional reflexivity throughout the development, implementation, and analysis of the *Lotions and Potions: Science through Hair Care* dissertation study, we understand the research presented in this chapter as part of a larger movement inclusive of experiences and societal issues of Black girls within STEM spaces (Butler, 2018). Probst and Berenson (2014) explain reflexivity as an "awareness of the influence the researcher has on what is being studied and, simultaneously, of how the researcher process affects the researcher. It is both a set of mind and a set of actions" (p. 814). That reflexivity as a set of mind and actions is the focus of this chapter. In the next sections, the type of data collected and analysis plan are outlined.

8.3.5 Data Collection

Inclusive of dramatic recall and retelling as the data (Richardson, 2000), data for this critical autoethnography were collected while the first author was in a four-year doctoral student being supervised by the second author in the second, third, and

fourth years of the doctoral program. The first author kept a research journal during the entire doctoral program. The first and second author met weekly to discuss in-process research projects, dissertation research planning, and other administrative details. As a part of the doctoral program, the first author organized a committee of five faculty members who were responsible for reviewing the dissertation proposal and final dissertation document.

The data for this study included journal reflections in the second, third, and fourth years of a four-year doctoral program, weekly advisor/advisee meeting notes, second, third, and fourth years, reflections collected after each dissertation class, and dissertation committee feedback in year three. The authors engaged in two cycles of coding, beginning with an open coding approach for identifying initial categories or themes (Creswell, 1998; Miles et al., 2014; Patton, 2002) then a second round of axial coding provide the opportunity to organize the initial codes into larger and related themes as aligned with four stages of grief.

8.4 Findings

In the next section, we outline how the loss of the attachment to Science expressed through the development and implementation of the culturally sustaining curriculum *Lotions and Potions: Science through Hair Care* led to grief. Throughout the remainder of the findings section, the first author, a Black female scientist and science educator, assumes the pronouns *I/me.* Although it is understood that the stages of grief are not linear, the transition through each stage is chronological from the development of the curriculum through the implementation of the curriculum.

8.4.1 Numbness

After experiencing winter in Philadelphia during the first year of the doctoral program, I started making my own hair and body lotions out of the need for more moisture in the drier, colder North East climate as compared to Florida where I was from. I enjoyed making products since it required the same skills and practices of science lab research and testing such as planning, measuring, mixing, and analyzing results. I also was very focused on figuring out a research path during the second year of the doctorate program. There was little to no connection from my personal life and my learning. Science had taught me to separate personal interests and ideas from scholarly research. By the start of my second year in the doctorate program, I was in the process of shifting supervising professors. Up until that point, the main topics I was exploring were underrepresented minorities in STEM, student perseverance in STEM, and teacher training. Particularly, I was interested in "features in the curricula that make it useful for teachers… What resources support teachers with the Next Generation Science Standards 3D frameworks" (journal notes January,

second year) and "Anything with gender, race, and Biology...like why do women choose Biology or other subjects in STEM?" (meeting notes). I had few ideas about research topics, but none of them deeply personal, but all relevant.

At the annual national educational conference in April of my second year was the first time I was attending the events with my advisor, the second author. In a few conversations, I had mentioned to him how making hair products should be in science labs, but it was just something fun to do at home in the kitchen. While at the conference, he introduced me to several science education professors and researchers. He asked that I share my research interests with them. I recall sharing my thoughts about teacher resource materials and professional development opportunities. After I had finished that sentence, he said "No, tell them about the hair care." This was the first time verbalizing that hair product making was science and connected to science practices. In my notes from that day, I wrote "I had NOT practiced that speech before. Can hair care even be a science practice? I don't know. I don't think so. I did not like being put on the spot… when did I ever do hair care in a science lab? I would rather never talk about that again. I need a project that is solid. Not one that I am making up. Absolutely not. How embarrassing! A second year student {that is} not even sure of their research ideas!" (journal notes April 15).

The idea of introducing something as personal as the hair products I made in my kitchen into my science education research plans felt wrong, impossible, and "not science-y enough". It was easier to ignore the pain that was felt when I was asked to connect science in a different way. I had not seen things like that done before. I was not sure it could be done. I did not want to "betray" Science. The thought alone was overwhelming, shocking, and ultimately resulted in numbness. After that interaction at the conference, I did not revisit the hair care curriculum except for a brief mention of "chemistry- hair products, lotion...co-constructing something" (meeting notes).

8.4.2 Yearning and Searching

During the next few months, I was preparing for the dissertation proposal which has to be completed by the end of the third year in the doctorate program. It was during these moments that I was beginning to see that I could no longer hold fast to the structure of curriculum content, design, and assessment that I was most familiar with from Science. I had been enjoying reading about the theory of decolonization. Particularly, I was learning and understanding more about the concepts and strategies that were useful to applying decolonization beyond a metaphor. However, examples of decolonization in science education were limited. The searching for examples and precedents left me wanting to see how decolonization was used as a theoretical framework especially. "Find methodologies for how to frame this work. What will be the design of the curriculum?" (from advisor meeting).

During these moments, my yearning for a template or example of the application of decolonization was very clear. My large questions were at this time "What are the

measuring pieces? How can we see what students are learning? ASSESSMENTS! What impact would my study have?" (from advisor meeting). I was searching for examples of the application of decolonization in formal and informal science K-12 educational spaces.

This time of dissertation planning was most difficult because my searching around decolonization led me to sociology research, dissertations using music and dance, and numerous theoretical and conceptual applications of decolonization. I was able to loosely connect some physics and chemistry research to hair care and hair follicle structure, but those works were not supportive of the framework of decolonization. The months of grief where I was dedicated to yearning and searching for a way to fill the void of Science curriculum and assessment development as I knew it ended with "I want Black girls to see themselves as scientists" (Journal notes from January 25). I still had outstanding questions like how will the students see themselves in the curriculum and who has done similar work before? But I was clear that I desired to develop a learning experience where Black girls were able to see themselves as scientists. I knew that meant unraveling what I knew Science to be. The journey of grief so far had led me through the numbness first experienced with letting go of science curriculum and assessment as I had experienced and taught with it. I knew that I could not replicate the science experiences that needed to be decolonized, but I was yearning and searching for a new way forward.

8.4.3 Disorganisation and Despair

It was during this time after yearning and searching for something to replace structures that were familiar that I presented my first iteration of how a decolonized middle school science curriculum about hair care could look. I defended my Dissertation Proposal in June of my third year to a committee of five faculty members. I had chosen four faculty members in addition to my Black male advisor to serve on my dissertation committee, two Black women and two Black men. The initial purpose was to identify faculty members that did not expect or require assimilation to a culture of power that was normal for science education and would make space for a dissertation project that could celebrate, encourage, or affirm ways of talking, seeing, and being in the world (Bang et al., 2012; Brown, 2004) that was not often seen in science education. These faculty members had deep expertise in areas of curriculum and instruction, identity development, and STEM education. I was certain that they were the best people to offer feedback on my evolving thoughts around a hair care science curriculum and appropriate assessment development.

Based on their feedback, I had not applied decolonization as my foundational framework. At that time, the proposal was supported by three research questions: (1) How is student learning of the macromolecules impacted by participation in a culturally sustaining science curriculum? (2) In what ways do students participate in scientific argumentation while engaging with a hair-care curriculum?, and (3) How are students perceiving scientific engagement and practices while experiencing a

culturally sustaining science curriculum? Each of the committee members made expressions such as "What's more important, the curriculum or the students?" which challenged where the focus of my dissertation was placed. The one comment that was most jarring during that review process was "Either you're going to decolonize or you aren't" which prompted me to review my entire dissertation proposal document. A brief content analysis of the 69 page proposal revealed the word *decolonize* was used only twice throughout the entire plan for the dissertation project. What the committee expressed is what I had been struggling with up to this point mainly the question "Does making hair care products constitute as science?" The committee strongly suggested refocusing the research to highlight decolonization in curriculum and assessment, ultimately leading directly to my disorganisation and despair around finding a better way to express the connections of hair care to science.

> I didn't know how angry I was. I didn't know who I was angry at. I just knew I was angry. I had to re-do THIS MUCH… the regular science stuff isn't expected of me. People aren't asking me to do what I know. Repeat what I know to be science learning and evaluation. But they aren't telling me what it should be! I'll acknowledge this anger, but what's the point? I have to use this energy some kind of way. Channel it into a better way to do science I guess. But I don't know how to do that OBVIOUSLY. (Journal notes July 23)

As a result, the first drafting of the "Lotions and Potions" curriculum had not fully removed traditional science experiences such as classroom power dynamics, high stakes testing, and limited expression of science understanding. Additionally, although I was centering hair care, the curriculum had the potential of being additive to current curricular resources rather than transformative (Banks & Banks, 2004). Ultimately, I desired to develop a transformative science curriculum that centered and affirmed Black hair culture, yet I had not fully imagined a decolonized science experience for Black girls. I was unsure how to proceed and was upset about the need for much reorganisation of the dissertation proposal when there was no sufficient template for this decolonization work. The attachment to colonizing science was most familiar and could be replicated easily since it had been internalized; however, the dissertation projected was focused on decolonizing and disrupting these attachments that ultimately led back to Whiteness as property and power in science.

8.4.4 Reorganisation

After defending the dissertation proposal, the feelings of disorganisation and despair were still very strong, but I had committed to teaching three of the lessons of the *Lotions and Potions* curriculum in two summer programs. After engaging with the summer program students who most of which identified as Black and observing the ways they were asking questions, developing and using models, and engaging in argument from evidence, I was encouraged to reorganize the overall plan for the

Lotions and Potions curriculum in a way that was informed by decolonization regardless of my personal attachments to colonizing science.

Considering the students experiencing the curriculum were Black, and I was a Black teacher leading these science lessons, in both settings, the after school lessons occurred beyond the White gaze. Paris and Alim (2014) incorporate Toni Morrison's reflection on the White gaze and positions this gaze as part of the culture of power:

> What would our pedagogies look like if this [White] gaze weren't the dominant one? What if, indeed, the goal of teaching and learning with youth of color was not ultimately to see how closely students could perform White middle-class norms but to explore, honor, extend, and, at times, problematize their heritage and community practices? (p. 86)

Essentially, Paris and Alim (2014) are questioning and calling for a method of teaching inclusive of curricular text that explores, honors, and extends students' various cultural expressions and ways of knowing. "What would a science curriculum that did not concern itself with the white gaze really look like?" (Journal notes July 30). After leading students through the making of hair products, I revisited the committee's feedback on the dissertation proposal. I used those teaching moments to attempt to apply the feedback that led to truly decolonize science content, experiential learning activities, and formative assessments that reordered power in a science learning space, centered student choice, and made way for the opportunity for students to be experts in their own learning.

The reorganization after hearing the committee's feedback and engaging with students while making hair products led to a large reorganization of the full dissertation research by detaching from science norms. The imperative to reconcile without transformation is reflective of appeasing and satisfying the oppressor rather than truthfully acknowledging and reimagining freedom for the oppressed (Tuck & Yang, 2012). I had to decide that the *Lotions and Potions* curriculum development and implementation would seek freedom for those marginalized and oppressed by science and science education.

The fourth-year implementation of revised lessons and assessments completed the reorganisation portion of the cycle. Reflections after each class highlight participation and engagement mostly. "The coloring pages that had been added to the curriculum of girls with different hair styles and curl patterns were a hit {with the students}. They really liked that strategy and they all shared that 'we want to color some more.' The comment sections of the curriculum were also a favorite. Students tried to press the button on the page" (After-class reflection).

The interdisciplinary lab space where the class was held required me to reorganize Whiteness as property in science education. After the students left the first-class session, I was still in the interdisciplinary lab when two white men entered. The white gaze was reintroduced to the space, and I began to ask if I was taking up too much of the work room since I had not finished clearing the worktable in the space. "The area {lab space} was tense again. And I was able to remember how just moments before the space was filled with joy, excitement, surprise, curiosity, mystery, questions, laughter, safety. The space was love until it wasn't" (After-class reflection). I had to participate in reorganising who was able to do science and what

science was permissible in the interdisciplinary space in a way I had not experienced in previous science spaces.

Other experiences of reorganisation while applying decolonization was a modeling activity where the instructions were for the girls to model their current hair pattern, but I did not plan for braided hairstyles and hair patterns under wet or dry conditions. “When we discussed curl patterns, I was unable to take into account the braids. A few of them asked for more pipe cleaners to model their curls. Some of them asked for more pipe cleaners for wet and dry hair. They did bring up shrinkage on their own!” (After-class reflection). To conclude, another example of the reorganisation I experienced was the way students were encouraged to work with their partners at their own pace. “They have to get used to doing things for themselves. Being competent. They can do it. I know they can. They have to want to and try. ‘At school, we can’t move on our own.” is what they have shared. How different is this curriculum from school? Not having the autonomy to move on to the next step” (After-class reflection).

Early renderings of the *Lotions and Potions* curriculum relied on knowledge and experiences of a “traditionally trained scientist” where limited expression of science understanding (Rosebery et al., 2016) through memorization and standardized assessment instruments led to positive outcomes in the class including high scores. However, the attachment to science through assimilating in science spaces due to practices such as memorization, lack of socializing, and muted cultural expression prevented the first author from embracing decolonization in praxis. The grief associated with losing the attachment to colonizing science was an integral part of the conceptualization and implementation of the *Lotions and Potions* curriculum. Only after reorganizing most of the curricular activities and formative assessment strategies was the curriculum able to be implemented in a way that rearticulated science learning and activities by providing a different content area, Black hair and product making.

8.5 Discussion

The *Lotions and Potions: Science through Hair Care* is a culturally sustaining science curriculum that was developed and implemented in a dissertation research study. To present a transformative (Banks & Banks, 2004) curriculum, Black hair care was centered as a science topic, and hair care practices such as Do it Yourself (DIY) product-making were used as assessment instruments. The findings presented in this chapter answer the question: *what is the process a self-identified Black woman scientist took in order to design and implement a science curriculum that highlighted Black hair and skin care*? The purpose of sharing the process of the development and implementation of the curriculum through critical autoethnography is to open conversations (Ellis, 2004) around the application of decolonization and reframe ideas around the application of decolonization. Along those lines, the first author had not been the subject of research for this dissertation project;

however, this chapter centers on the process for designing and implementing a decolonized science experience in addition to the product of a curriculum.

Attachments to science were disrupted by the development and implementation of the *Lotions and Potions* curriculum. Releasing these attachments were integral to reimagining the ways in which youth of color are provided opportunities to engage in and connect with science content (Wright, 2019). The two-step process of decolonization required the work of naming the complex, interwoven systems of oppression through extensive literature review. The work of reimagining and visioning experiences of Black women and girls in science education was preempted by deep personal work of detaching from colonized science which led to deep grief. We are expanding on our previous understanding of the application of decolonization to consider steps of grief as part of the process (see Fig. 8.4). We are supporting the process of decolonizing your own assumptions and expectations of what counts as science education research for partaking in research with girls from communities that have been historically excluded (Bang et al., 2012) from Science.

In conclusion, this study of self was important to share as concepts like *decolonization*, *transformation*, and *reimagining* are becoming more popular within science education. These theories are foundational for change and progress; moreover, these theories in praxis are also tangible and deeply emotional, unsettling, and challenging (Tuck & Yang, 2012). Scholars and communities often refer to doing "the work", and we would like to present that part of that difficult work is making space for the grief of separating from old systems and ways of thinking in order to vision

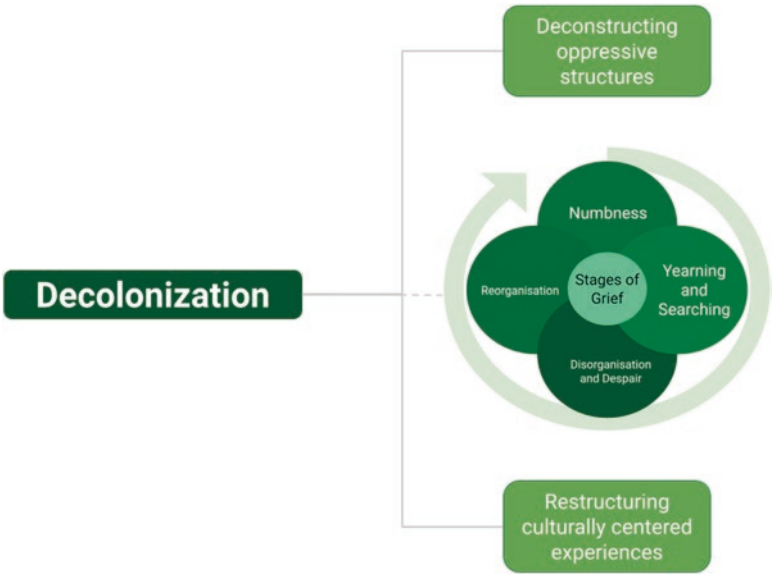

Fig. 8.4 Decolonization is a three-step process of deconstructing oppressive structures, of grief, as a cycle of numbness, yearning and searching, disorganisation and despair, reorganisation, and restructuring culturally-centered experiences. (Battiste, 2014; Higgins, 2016)

and create a freer way forward. In order to name and restructure systems without reproducing the same harms, making space for the grief associated with detaching from known and well-practiced systems should be considered. Imagining decolonization in science education means to detach from colonizing science practices. Our focus was on the grief cycle related to releasing attachments to Whiteness and participation in colonized science spaces in order to present a decolonized science experience.

Implications of the *Lotions and Potions* curriculum highlights the opportunity for curriculum developers and assessment designers to expand assessment instruments that center the active knowledge building of middle school learners through multimodal opportunities can raise sensitivity of instrument for the diversity of students. Another implication of the curriculum research is for teacher education programs to explore the ways cultural processes such as verbal expression of knowledge can be treated and acknowledged as assets (Bang & Medin, 2010) for evaluation and learning and in an effort to de-settle privileged ways of knowing within science. We are suggesting continued development and use of reflective methodologies that explore the identity development of the researchers and educators. Specifically, for "Black girls—and the researchers who work with them—are attentive to the ways race, class, gender, and additional interlocking identities… funnel into urban classrooms" (Butler, 2018, p. 29). We wanted Black girls to be able to see themselves centered in science materials and texts while considering how intersectional identities should be addressed through equitable interventions.

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