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The Importance of Intersectional Programming for Developing Black Middle School Girls' Future STEM Identities

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Chapter 1: Introduction

The number of women of color majoring in science, technology, engineering, and mathematics (STEM) and obtaining STEM careers remains significantly low despite the high number of women attending college. According to the Civil Rights Act and the Equal Opportunity Employment Commission of the 1960s, employers must diversify their hiring pool and stop discriminatory hiring practices against women and minorities across all industries, including STEM.[1] Shifting workplace culture to allow more women, especially women of color, to feel welcome in higher education and laboratories amongst mostly white male colleagues are demanding. The barriers to entry within the scientific community are even more laborious for women to overcome. While the number of women in science increased overtime, the numbers do not reflect real equity for women of color.[2]

Despite laws calling for more diversity in the workplace, significant gender and race disparities remain in numerous fields, including STEM. Even though more women attend college now than men, women are still underrepresented in science and engineering (S&E) majors. In 2016, women earned half of science and engineering bachelor's degrees, but women only received 44% of master's degrees and 41% of doctorate degrees.[3] We observe even lower numbers for minorities in STEM when compared to women. In 2016, underrepresented minorities (Hispanics or Latinos, Blacks or African Americans, and American Indians or Alaska Natives) earned 21.6% of bachelor's degrees, 13.2% of master's degrees, and 8.8% of doctorate

[1] "Ethnic/National Origin," U.S. Department of Labor Seal, https://www.dol.gov/general/topic/discrimination/ethnicdisc)
[2] Liana Christin Landivar, 2013, "Disparities in STEM Unemployment by Sex, Race, and Hispanic Origin," *American Community Survey Reports*, ACS-24, U.S. Census Bureau, Washington, DC.
[3] National Science Foundation. *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2019; 2019 ASI 9624-20*, 2019, 6.

degrees.[4] Combining race and gender, we see significant downward trends for women of color in STEM. Women of color received "only 9.9 percent of all doctorates awarded in science and engineering, while their representation in the general U.S. population was 16.4 percent."[5] The disadvantages women of color, particularly Black women, face in STEM reflect the U.S. education system's history of intersectional oppression. To course-correct STEM's intersectional failings, educators alongside community members should create STEM programming with intersectional frameworks specifically for Black girls. By creating targeted and effective STEM programming for Black girls, we can begin to dissolve the education system's gender and race barriers, subsequentially increasing the number of women of color in STEM careers.

Even though minority education progressed overall in the last several decades, this progress is not proportional to the United States' current minority population. Underrepresented minorities received "11% of S&E research doctorates despite comprising 27% of the population and about 30% of the labor force."[6] Historically speaking, the U.S. public education system excluded minority students. As will be discussed in Chapter 2, the U.S. education system denied underrepresented groups, particularly people of color, women, and women of color, the right to an equal education.[7] This educational discrimination reflects the U.S.'s troubled racial history from prohibited literacy for African Americans during slavery to segregated schools under Jim Crow laws through *Brown v. Board of Education* in 1954 into the present day. This disproportionate quality in education by race is seen today in the overpopulation of inner-city

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[4] "Field of Degree: Minorities," NSF. https://ncses.nsf.gov/pubs/nsf19304/digest/field-of-degree-minorities#degrees-earned-by-underrepresented-minosrities)

[5] Maria Ong et al., "Inside the Double Bind: A Synthesis of Empirical Research on Undergraduate and Graduate Women of Color in Science, Technology, Engineering, and Mathematics," *Harvard Educational Review* 81, no. 2 (2011): 174.

[6] National Science Foundation. Women, Minorities, and Persons with Disabilities in Science and Engineering: 2019; 2019 ASI 9624-20, 2019, 3.

[7] Lorelle Espinosa, "Pipelines and Pathways: Women of Color in Undergraduate STEM Majors and the College Experiences That Contribute to Persistence," *Harvard Educational Review* 81, no. 2 (2011): 209-210.

schools, the defunding of bussing programs, and the redlining of black and white school districts.[8] Even with concerted effort, women and people of color receive advanced STEM education at lower rates than white men, which reigns especially true for women of color.[9]

Women of color face many systemic barriers in STEM education because of the intersection of their race and gender. The experience of women of color within higher education is an expanding field of study with growing quantitative and qualitative data that illustrates how their distinct background impacts how they navigate society.[10] Women of color attending college or university share a negative pattern of experiences, including "isolation, invisibility, negotiating / navigation, microaggressions, sense of belonging, and tokenism."[11] These obstacles, explored more in Chapter 3, especially present themselves in a STEM setting with even fewer peers to identify with them. As a result, we see a substantial drop-off in the number of women of color who complete advanced degrees and attain employment in STEM compared to men, white men, and white women.[12] Narrowing the focus from all women of color to Black women, we see the further implications of systemic racism and its impacts on the education system. In the U.S., Black women have different STEM experiences than white women. Despite an overall increase of women majoring in STEM over the past several decades, there is a decrease in Black women earning degrees in specific STEM majors. From 1996 to 2016, there

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[8] "Segregated Neighborhoods, Segregated Schools?" Urban Institute, April 11, 2020, https://www.urban.org/features/segregated-neighborhoods-segregated-schools)

[9] National Science Foundation, National Center for Science and Engineering Statistics. (2017). Women, Minorities, and Persons with Disabilities in Science and Engineering: 2017. Special Report NSF 17-310. Arlington, VA. www.nsf.gov/statistics.wmpd/

[10] Viveka Borum and Erica Walker. "What Makes the Difference? Black Women's Undergraduate and Graduate Experiences in Mathematics." *Journal of Negro Education* 81, no. 4 (Oct, 2012).

[11] Maria Ong et al., "Inside the Double Bind: A Synthesis of Empirical Research on Undergraduate and Graduate Women of Color in Science, Technology, Engineering, and Mathematics," *Harvard Educational Review* 81, no. 2 (2011): 176.

[12] Cary Funk and Kim Parker, "Women and Men in STEM Often at Odds Over Workplace Equity," Pew Research Center's Social & Demographic Trends Project, August 21, 2020. https://www.pewsocialtrends.org/2018/01/09/women-and-men-in-stem-often-at-odds-over-workplace-equity/

was a significant decline in the number of Black women receiving S&E degrees in computer science (4.9% to 2.2%), mathematics and statistics (3.8% to 2.1%), physical sciences (3.1% to 2.5%) and engineering (1.6% to 1.0%) and an increase in biological sciences (3.5% to 4.5%), psychology (6.2% to 9.6%) and social sciences (5.8% to 7.0%).[13] These numbers represent the double bind.[14] The double bind speaks to the inherent issue of racial and gender bias many Black women face in most industries. In this thesis, I argue that the current STEM education system does not support Black women because it locks them out of potential learning opportunities by denying them the right to an equal education received by their white peers.

Diversity in STEM, touted for years as a symbolic phrase to show that the sciences are not biased, is simply not the case despite the various advantages diversity brings to the STEM community. Many logical arguments support the call for diversity in STEM. For example, fostering competition with other countries in science and technology, creating a more balanced and unbiased lab environment, and bringing in unique perspectives that propel research forward to help people from all walks of life are sound arguments for increased diversity in STEM.[15] If scientists proclaim that their studies are quantitative and unbiased, their labs should reflect that sentiment. Increased diversity in a lab setting will only support the spirit of science, which seeks "broad-based solutions" to the problems faced by a wide range of people in the outside world.[16] Those who help to find these broad-based solutions should reflect the population they serve.

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[13] "Field of Degree: Women, Men, and Racial and Ethnic Groups." NSF. https://ncses.nsf.gov/pubs/nsf19304/digest/field-of-degree-women-men-and-racial-and-ethnic-groups#bachelor-s-degrees.

[14] Malcom, Shirley Mahaley and Others. *The Double Bind: The Price of being a Minority Woman in Science. Report of a Conference of Minority Women Scientists, Arlie House, Warrenton, Virginia* American Association for the Advancement of Science, 1515 Massachusetts Avenue, N.W., Washington, D.C. 20005, 1976.

[15] Mary V. Alfred, Sarah M. Ray, and Michele A. Johnson. "Advancing Women of Color in STEM: An Imperative for U.S. Global Competitiveness." *Advances in Developing Human Resources* 21, no. 1 (2019).

[16] Lorelle Espinosa, "Pipelines and Pathways: Women of Color in Undergraduate STEM Majors and the College Experiences That Contribute to Persistence," *Harvard Educational Review* 81, no. 2 (2011): 211.

Therefore, women of color in STEM spaces will bring new attention, innovations, and research to underserved populations. Their unique perspective allows them to spotlight issues others would not notice. Women of color hold "the potential for resolving national concerns such as race/ethnicity-based health disparities and environmental concerns."[17] Increasing studies on Black women and women of color in public health, for example, could dramatically affect treatments prescribed to these groups, their pain level assessments, and prenatal care for Black women in hospitals.[18]

Another reason to increase diversity in STEM is to increase international competition. The United States has fallen behind the world in STEM education. We consistently underperform globally in math and science at the K-12 level. While we herald Western schools of higher education, we produce fewer STEM graduates than China, South Korea, and France. "Currently only about 16 percent of undergraduates in U.S. institutions receive degrees in natural sciences and engineering, compared to 47 percent of undergraduates in China, 38 percent in South Korea and 27 percent in France."[19] The United States Department of Labor Bureau of Labor Statistics projected an increase in jobs in science and technology from 2012 to 2022 with "jobs in chemistry and materials science projected to grow by 6%; in geoscience by 16%; in physics and astronomy by 10%; in mathematics by 23-27%, and in computer and information technology by 8% for computer programmers to 37% for information security analysts."[20]

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[17] Maria Ong et al., "Inside the Double Bind: A Synthesis of Empirical Research on Undergraduate and Graduate Women of Color in Science, Technology, Engineering, and Mathematics," *Harvard Educational Review* 81, no. 2 (2011): 176.

[18] "The Disparities in Healthcare for Black Women," Endometriosis: Causes - Symptoms - Diagnosis - and Treatment, June 08, 2020, https://www.endofound.org/the-disparities-in-healthcare-for-black-women

[19] Maria Ong et al., "Inside the Double Bind: A Synthesis of Empirical Research on Undergraduate and Graduate Women of Color in Science, Technology, Engineering, and Mathematics," *Harvard Educational Review* 81, no. 2 (2011): 173.

[20] Peggy Doerschuk, Cristian Bahrim, Jennifer Daniel, Joseph Kruger, Judith Mann, and Cristopher Martin. "Closing the Gaps and Filling the STEM Pipeline: A Multidisciplinary Approach." *Journal of Science Education and Technology* 25, no. 4 (2016): 682.

However, the National Science Board's Science and Engineering Indicators claim a stagnation in the number of students who graduate with STEM degrees over the past decade, so who are taking these positions?[21] Why not look in our backyard for this massive labor force. Women of color are an invaluable resource that can increase the U.S.'s numbers in STEM and compete on the international STEM stage. They "represent tremendous untapped human capital and could further provide a much-needed force for sustaining America's economic vitality."[22] However, to reach this untapped potential, we must first identify the problems women of color face and learn how to adjust accordingly to blend them into the scientific community seamlessly.

Black feminist theory is the framework of this thesis and supports the argument that increasing the number of women of color in STEM will be beneficial for all parties, not just women of color, explained further in Chapter 4. Stepping back and looking at the history of feminism, we see parallels between second-wave feminism and the push for women of color in STEM. The second wave feminist movement that occurred from the early 1960s to the late 1970s was in conjunction with the Civil Rights Movement.[23] To build support for both causes, some interactive coalitions between the movements took place. Compared to first-wave feminists, who focused on procuring the right to vote for white women, second-wave feminists showed a slight increase in empathy for women of color's problems.[24] However, even though it coincided with the Civil Rights Movement, second-wave feminism failed to unify women of diverse

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[21] Peggy Doerschuk, Cristian Bahrim, Jennifer Daniel, Joseph Kruger, Judith Mann, and Cristopher Martin. "Closing the Gaps and Filling the STEM Pipeline: A Multidisciplinary Approach." *Journal of Science Education and Technology* 25, no. 4 (2016): 682.
[22] Maria Ong et al., "Inside the Double Bind: A Synthesis of Empirical Research on Undergraduate and Graduate Women of Color in Science, Technology, Engineering, and Mathematics," *Harvard Educational Review* 81, no. 2 (2011): 173.
[23] Julie A. Clements. "Participatory Democracy: The Bridge from Civil Rights to Women's Liberation" in The Public Purpose: The Interdisciplinary Journal of American's University School of Public Affairs (2003).
[24] Becky Little, "How Early Suffragists Sold Out Black Women," History.com, November 08, 2017, https://www.history.com/news/suffragists-vote-black-women

backgrounds. The movement's tendency to hyper-focus on gender issues excluded women of color with differing ideologies and caused separatist feminist groups. As a response to being ostracized by the feminist movement, Black female thinkers began the Black feminist movement. The works of Patricia Hill Collins and Kimberlé Crenshaw, examined in this thesis, demonstrate how intersectionality plays a significant role in Black women's lives and how using an intersectional lens when developing targeted STEM programming benefits everyone, not just Black women.

The study of Black women's intersectional vulnerability because of their racial and gender confluence is rare within a STEM context. The 1976 paper *The Double Bind: The Price of Being a Minority Women in Science* addressed this vulnerability as the double bind: "the unique challenges minority women faced as they simultaneously experienced sexism and racism in their STEM careers."[25] The double bind metaphor explains the challenges Black women in STEM must reconcile with as they progress through their STEM education and throughout their careers. These challenges include microaggressions in the workplace, isolation from peers and colleagues, and disengagement from their surroundings. These problems are "a pragmatic result of ignoring culture and ethnicity" and, unfortunately, "students who do not share the culture and ethnic background of the culture of power" have to either assimilate or be bogged down by these discriminatory acts daily.[26] To make it through the difficult challenges the double bind presents to Black women, I argue that STEM programming with an intersectional framework should be in place to help Black women get STEM careers outside the traditional STEM pipeline.

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[25] Maria Ong et al., "Inside the Double Bind: A Synthesis of Empirical Research on Undergraduate and Graduate Women of Color in Science, Technology, Engineering, and Mathematics," *Harvard Educational Review* 81, no. 2 (2011): 175.

[26] Bryan A. Brown, J. Bryan Henderson, Salina Gray, Brian Donovan, Shayna Sullivan, Alexis Patterson, and William Waggstaff. "From Description to Explanation: An Empirical Exploration of the African-American Pipeline Problem in STEM." *Journal of Research in Science Teaching* 53, no. 1 (2016): 174.

The STEM pipeline is the educational pathway for students in STEM fields. Some educators claim the STEM pipeline starts at the beginning of high school with students entering the ninth grade and ends with obtaining a bachelor's degree in STEM, a graduate degree in STEM, or a STEM career.[27] For this thesis, I argue that the STEM pipeline begins in middle school, with students ages ten to twelve, and ends with completing a bachelor's degree in STEM at a four-year institution because middle school is a critical time for students' personal growth and academic trajectory. "Middle school is a time when [students'] choices for peer groups, mentors, grades, and afterschool programs play a pivotal role in the high school trajectories they pursue."[28] I also argue that the STEM pipeline should begin with middle school rather than high school because the necessary courses to fair well in college start in middle school. To graduate timely with a high school diploma in the usual four years, students must take STEM courses that will put them ahead by the time they are in high school. This pathway typically begins with pre-requisite courses, like Algebra I, a requirement for STEM classes in high schools such as pre-calculus, calculus, chemistry, and physics.[29] Once in high school, students looking to pursue higher education in STEM need to take more advanced placement (A.P.) courses in science and mathematics, like A.P. Chemistry, A.P. Physics, A.P. Calculus AB, etc. These A.P. courses help to secure acceptance in a two- or four-year school and help prepare students to take college-level STEM courses once accepted and give them credit towards their degrees. However, many students of color do not have access to advanced STEM courses. "In high-poverty urban schools in the United States, students lack access to rigorous and high-level science courses; science

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[27] M. S. Franco, Nimisha H. Patel, and Jill Lindsey. "Are STEM High School Students Entering the STEM Pipeline?" *NCSSSMST Journal* 17, no. 1 (Apr, 2012).
[28] Angela Calabrese Barton, Edna Tan, and Ann Rivet. "Creating Hybrid Spaces for Engaging School Science among Urban Middle School Girls." *American Educational Research Journal* 45, no. 1 (2008): 72.
[29] "A Leak in the STEM Pipeline: Taking Algebra Early," Home, https://www2.ed.gov/datastory/stem/algebra/index.html

equipment; appropriate role models; and certified, qualified teachers."[30] After graduating from high school, the goal during a student's time as an undergraduate is keeping STEM as one's interest and major throughout the four years to graduate with a STEM degree and exit the pipeline. The problem here lies in racial retention because students of color can fall out of STEM pipeline at any point, more so than other students, due to systemic issues.

Specific leakage points in the pipeline occur during crucial transitions in education. Middle school is one such period of change. I argue that a possible solution to the leaky STEM pipeline is to create targeted STEM programming for Black middle school girls. Brickhouse identifies the science classroom as a distinct science community that fosters girls' self-identities while simultaneously molding their scientific views.[31] As the two depictions of self and science merge, girls can imagine themselves as future STEM leaders. Intersectional STEM programming can achieve this identity convergence by looking at Black girls as individual people with unique experiences rather than monoliths. STEM programs with an intersectional lens work towards increasing the number of women of color in STEM outside the traditional pipeline system.

One such program is the Mathematics, Engineering, Science Achievement (MESA) Program, described in Chapter 5. The MESA Program started in 1969, assumed from the beginning that minority students could achieve, and went against the discriminatory beliefs of the time that students of color were academically inferior to white students. This program defines itself as one seeking to help underserved schools in low-income communities of color that lacked the resources to properly educate and prepare their students for higher education in math and engineering. Through college advising, tutoring, field trips, summer employment, and peer

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[30] Angela Calabrese Barton, Edna Tan, and Ann Rivet. "Creating Hybrid Spaces for Engaging School Science among Urban Middle School Girls." *American Educational Research Journal* 45, no. 1 (2008): 72.
[31] Nancy W. Brickhouse, Patricia Lowery, and Katherine Schultz. "What Kind of a Girl does Science? the Construction of School Science Identities." *Journal of Research in Science Teaching* 37, no. 5 (2000).

support from minority teachers in STEM, minority undergraduate students majoring in STEM and STEM minority industry professional MESA give students of color a window to a future of higher education and STEM careers. From 1975 to 1993, the number of bachelor's degrees granted to minority engineering students in California increased from 6.79% to 10.46%.[32] The number of bachelor's degrees granted to minority engineering students in the U.S. from 1975 to 1993 increased from 4.15% to 7.95%.[33] We see that California was significantly over the national average, potentially showing the MESA Program's impact. In fifty years, MESA grew from serving one school in Oakland, California, to serving over 350 schools across nine states in 2020.[34] The program has been recognized as one of the top programs serving K-12 students in science and received the Presidential Award for Excellence in Science, Engineering, and Mentoring.[35] As a program made for minority students, supported by faculty, staff, and mentors of color, the MESA program demonstrates the effectiveness of intersectionality in STEM.

In this thesis, I will argue that Black women can become future STEM leaders if given the proper support from intersectional STEM programs starting in middle school. By using an intersectional lens to identify and speak to the Black girl experience, these inclusive programs can provide Black middle school girls the tools to develop their self-identity within science and advancing them to higher education, regardless of what the STEM pipeline dictates. These programs will continue to provide Black women with the support they need throughout their college years. Whether it is in the form of cultural community support to prevent feelings of isolation, financial aid, or mentorship, these programs will remain by their side as empathetic

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[32] Wilbur H. Somerton. *The MESA Way: A Success Story of Nurturing Minorities for Math/science-based Careers*. San Francisco, CA: Caddo Gap Press, 1994, 185.
[33] Ibid, 183.
[34] "Home," MESA USA, June 24, 2020, https://mesausa.org/
[35] "OLPA - PR 00-59: President Clinton Honors Science, Mathematics and Engineering Mentors," NSF, https://www.nsf.gov/od/lpa/news/press/00/pr0059.htm

advocates. The experiences of Black women are valid and valuable in STEM and deserve recognition as such. To increase the number of Black women declaring STEM majors, graduating with STEM degrees, and obtaining STEM careers, we need to begin by looking at education from their perspective.

Chapter 2: Black Education from Reconstruction to *Brown v. Board of Education*

The history of the United States' public education system consists of racial and socioeconomic disparity. Within the U.S. education system, individual legal battles for educational equality only did so much in the long-term for disenfranchised children looking for a brighter future through academics. From the mid-1800s to the end of the 1900s, the Reconstruction Era (1864-1877) and the Modern Black Freedom Movement (1955-1975) took place.[36] During this time, African Americans sought advancement in many social spheres, including education, through desegregation. This chapter will briefly go over Reconstruction, segregation, and Jim Crow in the United States. It will then examine the Supreme Court case *Brown v. Board of Education* and cases pre- and post-Brown. Finally, it will conclude with an analysis of Brown and its various limitations.

African Americans from times of slavery through the days of Jim Crow experienced barriers towards educational advancement. Having the right to an education was an inconceivable notion for slaves in the Antebellum South. Learning to read or write was a legally punishable offense on slave plantations. For example, "in Georgia, enslaved Africans or other free people of color were fined or whipped, at the discretion of the court, if discovered reading or writing 'in either written or printed characters.'"[37] After the Civil War and the passing of the Thirteenth, Fourteenth and Fifteenth Amendments, slaves were freed, became legal citizens, and Black men were eligible to vote for the first time, respectively.[38] The Reconstruction Era saw more African Americans using their newfound democratic freedom by taking political office.

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[36] "Reconstruction Timeline." PBS. https://www.pbs.org/wgbh/americanexperience/features/reconstruction-timeline/
[37] Rebecca Epstein, Jamilia J. Blake and Thalia González. (2017). Girlhood interrupted: The erasure of Black girls' childhood. Center on Poverty and Inequality, 12.
[38] "Landmark Legislation: Thirteenth, Fourteenth, & Fifteenth Amendments." U.S. Senate: Landmark Legislation: Thirteenth, Fourteenth, & Fifteenth Amendments. February 11, 2020. https://www.senate.gov/artandhistory/history/common/generic/CivilWarAmendments.htm

Federal programs like the Freedmen's Bureau provided African Americans some tools to prosper, such as access to education, albeit a segregated one.[39] However, this time of democratic prosperity in the Black community was short-lived as racial tensions grew in the South. The formation of the Klu Klux Klan in 1866 and the return of a Democratic majority in Congress stripped political freedoms away from black citizens. As the period of Reconstruction ended, blacks saw their newfound rights abruptly infringed upon with the sanction of Jim Crow laws.

A newly freed generation of African Americans also saw themselves back in a quasi-slavery state with the introduction of Jim Crow laws. The disadvantages Black people in the U.S. faced due to Jim Crow laws regressed the Black community practically back to slave-like conditions. States enacted Jim Crow laws and set up intense voting restrictions (literacy tests, grandfather clause, etc.) to intimidate African Americans from participating in the voting process.[40] Enslavement of African Americans continued at this time under the guise of criminal justice and sharecropping. According to the Thirteenth Amendment, slavery was now an illegal act except for criminals.[41] Southern plantation owners, who had lost their labor force after the Civil War and were experiencing an economic downturn, exploited the Thirteenth Amendment's loophole by criminalizing the former slave population. To re-enter African Americans into the slave economy, patrollers arrested Black people in mass quantities for minor infractions such as looting and vagrancy.[42] Harsh corporal punishment such as public lynching also upheld white supremacy in the South.

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[39] "Schools and Education During Reconstruction." PBS. https://www.pbs.org/wgbh/americanexperience/features/reconstruction-schools-and-education-during-reconstruction/

[40] "Voting Rights for Blacks and Poor Whites in the Jim Crow South." America's Black Holocaust Museum. August 24, 2020. https://www.abhmuseum.org/voting-rights-for-blacks-and-poor-whites-in-the-jim-crow-south/

[41] "Experts Explain the Slavery Loophole in the 13th Amendment." PBS. https://www.pbs.org/wnet/amanpour-and-company/video/experts-explain-the-slavery-loophole-in-the-13th-amendment/

[42] Ava Duvernay and Jason Moran. 13TH. USA, 2016.

In 1890, the separate but equal doctrine found in a Louisiana Jim Crow law segregated railroad cars for black and white patrons. Homer Plessy, arrested in 1892 because of this doctrine, would make his way to the Supreme Court by 1896 via *Plessy v. Ferguson*. *Plessy v. Ferguson* upheld the constitutionality of "separate but equal."[43] The ruling solidified the white supremacist logic that segregation treats everyone the same way but instead breeds a sense of inferiority between races, with blacks being inferior to whites. Black people lived as second-class citizens through the segregation of public spaces in a nation that simultaneously thought of them as free citizens. African Americans suffered "severe job discrimination; political exclusion including disfranchisement; civic disabilities; [...] social ostracism and residential segregation; exclusion from the public domain of schools, churches, hotels, restaurants, pubs, halls, and conveyances; and antiblack terrorism."[44] These disparities are demonstrated in the public education system as black segregated schools received less funding than white schools in the same neighborhoods. For example, in 1950, black schools' total value in Clarendon County, South Carolina, was $194,575, $479,275 less than the county's white schools' value, which was $673,850.[45] This socioeconomic difference was also seen in teacher salaries as "black teachers earned two-thirds less than their white counterparts."[46] While Reconstruction initially provided the Black community with political and educational support from the federal government, state-sanctioned Jim Crow laws took these support systems away.

After experiencing a taste of freedom during the Reconstruction era, a generation of Black people wanted that joy back and fought many legal battles alongside the National

[43] *Plessy v. Ferguson*, 163 U.S. 537 (1896).
[44] Waldo E. Martin, *Brown v. Board of Education: A Brief History with Documents* (Boston: Bedford/St. Martins, 1998), 3.
[45] Ibid, 2.
[46] Ibid.

Association for the Advancement of Colored People (NAACP) to reclaim it. Multiple legal cases preceding *Brown v. Board of Educatio*n upheld institutions of segregation and Jim Crow laws, such as *Plessy v. Ferguson* and *Roberts v. The City of Boston*.[47] However, after the NAACP's founding in 1909, there were more court wins for African Americans concerning educational and racial equality. Tired of the constant racial injustices within the court system, the NAACP declared its mission to combat Black people's daily racial injustices across the U.S. One of the main goals of the NAACP was to desegregate higher education institutions. There were several cases on the journey towards *Brown v. Board of Education* that contributed to the NAACP's campaign for racial equality in the United States. The decision here to focus on graduate school and colleges marked a critical tactic used by lawyer Charles Houston and his mentee, Supreme Court Justice Thurgood Marshall, in civil rights law.[48] On a case-by-case basis, the overwhelming disparities between resources at black and white institutions were too apparent to discredit. The universities could not fix these systemic issues readily enough to maintain the "separate but equal" argument. Black law schools "lacked the many advantages of the traditional all-white law schools and were thus a blatant denial of equal educational opportunity."[49]

In *Pearson v. Murray*, Donald Murray, a black Amherst College graduate, was denied an equal educational opportunity when the University of Maryland's law school refused to admit him. Murray either had to be immediately admitted to Maryland's School of Law or a separate but equal law school.[50] Since the university could not build a comparable black law school overnight, the University of Maryland admitted Murray to the white law school.[51] Other cases

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[47] *Roberts v. City of Boston*, 59 Mass. 198, 5 Cush. 198 (1849).
[48] "NAACP Legal History." NAACP. November 02, 2018. https://naacp.org/naacp-legal-team/naacp-legal-history/
[49] Waldo E. Martin, *Brown v. Board of Education: A Brief History with Documents* (Boston: Bedford/St. Martins, 1998), 26.
[50] *Murray v. Pearson*, 169 Md. 478, 182 A. 590 (1936).
[51] Waldo E. Martin, *Brown v. Board of Education: A Brief History with Documents* (Boston: Bedford/St. Martins, 1998), 25.

involving discrimination and segregation in graduate and professional schools followed suit, such as *Missouri ex rel. Gaines v. Canada* in 1938 and *Sipuel v. Oklahoma State Regents* in 1948. To slow down the NAACP's integration progress, "racist southern school districts used various legal strategies to tie up the proceedings and to exhaust black litigants financially and emotionally."[52] These school districts would admit to the evident inequalities when comparing different schools but would fabricate measures that promised policy changes. Their efforts would not stop the NAACP in their pursuit of desegregation. After this long game strategy proved useful, the NAACP ramped up the number of cases involving public elementary schools and combined them to file a class-action suit known as *Brown v. Board of Education*.

Brown v. Board of Education tackled segregation within the public-school system and would jump-start civil rights legislation in other segregated systems and propel the Black Freedom Movement through the 1970s. Five cases made up *Brown v. Board of Education*, *Brown v. Board of Education of Topeka, Kansas*, *Briggs v. Elliott*, *Davis v. County School Board of Prince Edward County*, *Belton v. Gebhart,* and *Bolling v. Sharpe.*[53] The NAACP chose these cases for their similar backgrounds: schools with about the same number of resources but distinct student body populations that were either overwhelmingly white or black. This tactical legal strategy shifted from the NAACP's original argument of unequal facilities in graduate schools to making this case squarely about segregated schools' intangible problems. In cases like *Sweatt v. Painter,* the plaintiff's argued that segregated schools created "a sense of inferiority [which] affects the motivation of a child to learn"[54] Ultimately, the Supreme Court deemed that "in the

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[52] Waldo E. Martin, *Brown v. Board of Education: A Brief History with Documents* (Boston: Bedford/St. Martins, 1998),14.
[53] "History - Brown v. Board of Education Re-enactment." United States Courts. https://www.uscourts.gov/educational-resources/educational-activities/history-brown-v-board-education-re-enactment.
[54] Waldo E. Martin, *Brown v. Board of Education: A Brief History with Documents* (Boston: Bedford/St. Martins, 1998), 174.

field of public education the doctrine of 'separate but equal' has no place. Separate educational facilities are inherently unequal." [55] However, this ruling did not come without criticism.

The Supreme Court's verdict in *Brown v. Board of Education*, while monumental, received criticism for its vague nature, lack of urgency, and protection of the white middle-class. Lewis M. Steel called out the Supreme Court's racist history in a 1968 New York Times article. He detailed how the Court previously struck down desegregated public accommodations in the Reconstruction Era and later upheld the "separate but equal" clause in the 14th Amendment with Plessy v. Fergusson.[56] Steel believed the Supreme Court purposefully waited to enforce school integration to protect the white middle class from these coming adjustments. "Rather than ordering sweeping desegregation, it ordered another hearing. A year later, the Court ruled that the South did not have to immediately desegregate its schools; it merely had to do so 'with all deliberate speed. […] The Court thereby made clear that it was a white court which would protect the interests of white America in the maintenance of stable institutions."[57] Scholar Kimberle Crenshaw also critiqued Brown but for its vagueness, as it purports the idea of color blindness in the nation's justice system. The Supreme Court did not explicitly address race in its ruling. It only referred to the plaintiff's arguments regarding the sociological and psychological impacts of school segregation on Black children. By not taking into account race and merely deeming segregated schools unconstitutional, the Court classifies all students in public education as the same and thus symbolically erasing the problems Black students in the education system face without actually fixing any of them. As we will discuss in the next chapter, Black students face different structural issues in education than white students, and "treating different things the

[55] *Plessy v. Ferguson*, 163 U.S. 537 (1896).
[56] Lewis M. Steel. "A Critic's View of the Warren Court -Nine Men in Black Who Think White: Nine Men in Black Who Think White." *New York Times (1923-Current File)*, Oct 13, 1968.
[57] Ibid.

same can generate as much an inequality as treating the same things differently."[58] The current structures in education today stem from racist origins of literacy prohibition and school segregation. This history reflects itself in the educational pathways available to all students being successful for white students but unsuccessful for Black students and students of color, particularly in the sciences.

[58] Kimberle Crenshaw. "Color Blindness, History, and the Law" in Lubiano, Wahneema H. *The House that Race Built: Black Americans, U.S. Terrain*. 1st ed. New York: Pantheon Books, 1997, 285.

Chapter 3: Women of Color Navigating the STEM Pipeline to Higher Education

The STEM pipeline is a common metaphor used to explain the sequential steps needed to achieve a STEM career. Starting from high school through college and ending with employment, the STEM pipeline provides a road map for students towards a STEM career. It tells potential STEM students what classes to take and what schools to go to and what career options lie ahead once they have made it out the other side. This regimented pathway also "encapsulates a widely held perception that fewer students select careers in STEM than earn degrees in STEM; fewer students earn degrees in STEM than select majors in STEM, and fewer students graduate from high school prepared to pursue majors in STEM than enter high school."[59] As the STEM pipeline progresses, more and more students "leak out" of the system. The pipes narrow as students make their way through elementary, middle, and high school. Students are continuously drained out of a possible STEM future as they enter college, declare majors, and move on to graduate school. This narrowing effect in the pipeline metaphor assumes that students leak out for a failure to complete specific benchmarks because all criteria need to be completed at a particular time to exit the pipeline.[60] Although the number of students who start with an interest in STEM in high school is smaller than the number who obtain STEM jobs, I argue that these leaks are not a matter of failing to take a particular science or math course. Systemic issues cause many potential STEM leaders to leak out of the pipeline, especially minorities, women, and women of color. The STEM pipeline's failure to address non-white female students' needs through an intersectional lens is one reason for the continued leakage seen in STEM education and the low numbers of women of color in STEM careers.

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[59] Matthew A. Cannady, Eric Greenwald, and Kimberly N. Harris. "Problematizing the STEM Pipeline Metaphor: Is the STEM Pipeline Metaphor Serving our Students and the STEM Workforce?" *Science Education (Salem, Mass.)* 98, no. 3 (2014): 444.
[60] Ibid, 445.

The STEM pipeline is made for white male students to succeed in a scientific community with a majority white male composition. The scientific community is composed of the students, faculty, and staff in higher academia supporting science and math majors and the future employers of STEM graduates in both research and industry. This community, with its "scientific culture, which subsumes both the academic and professional STEM workplace, is an artifact of larger societal norms and tends to reflect the socialization and learning styles of White men."[61] The hallways in science buildings across the country demonstrate STEM's whitewashed history through the walls ridden with portraits of Nobel Prize winners, old white men.[62] "Science in general, as a cultural practice, has been shaped by the ideas, experiences, and biases of white middle-class males," so it can be safe to assume that the pathway to learn about science and to become a scientist shapes itself around white male ideologies.[63] As we approach modern times with western education, where more women and minorities could receive college degrees, the science culture did not shift to welcome its new members. Instead, female and minority STEM students must choose to forcefully assimilate to the scientific community's white male norms or completely isolate themselves.[64] This decision was overly burdensome for women of color who faced both racial and gender stereotypes of white male science culture. The minority's need to adjust rather than the majority suggests "a culture of privilege that [produces] feelings of cultural

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[61] Matthew A. Cannady, Eric Greenwald, and Kimberly N. Harris. "Problematizing the STEM Pipeline Metaphor: Is the STEM Pipeline Metaphor Serving our Students and the STEM Workforce?" *Science Education (Salem, Mass.)* 98, no. 3 (2014): 447.

[62] Michael Greshko. "Who Are the Nobel Prize Winners? We've Crunched the Numbers." National Geographic News. October 03, 2018. https://www.nationalgeographic.com/news/2017/10/nobel-prize-winners-laureates-charts-graphics-science/?cmpid=org&rid=A5432A2B4450617D14233082A7EA6CF0.

[63] Hosun Kang, Angela Calabrese Barton, Edna Tan, Sandra Simpkins, Hyang-yon Rhee, and Chandler Turner. "How do Middle School Girls of Color Develop STEM Identities? Middle School Girls' Participation in Science Activities and Identification with STEM Careers." *Science Education* 103, no. 2 (03, 2019): 423.

[64] Danyelle T. Ireland, Kimberley Edelin Freeman, Cynthia E. Winston-Proctor, Kendra D. DeLaine, Stacey McDonald Lowe, and Kamilah M. Woodson. "(Un)Hidden Figures: A Synthesis of Research Examining the Intersectional Experiences of Black Women and Girls in STEM Education." *Review of Research in Education* 42, no. 1 (2018).

misalignment based on gender and racial privilege" within the scientific community.[65] To combat this practice of power culture and white male privilege, Black women need to reckon with how they expect to progress through their science education and advance to science careers. "Education research and practice efforts to address diversity issues in STEM have failed to adequately contend with the ways U.S. institutions have historically marginalized students of color while educationally privileging both whiteness and maleness" because they continue to use the same systems that upheld white supremacy in education to introduce women and minorities.[66] Unlike the STEM pipeline, modeled with only white male students in mind, these new frameworks need to consider minority female students' experiences to increase STEM participation overall.

Women of color (WOC) in STEM experience microaggressions and isolation due to the STEM pipeline's intersectional failings in acknowledging WOC's unique experiences. Black women continue to remain underrepresented in STEM despite making up 7% of the U.S. population.[67] As the minority in multiple senses of the word, women of color in STEM regularly succumb to isolation to cope with the scientific community's majority white male reality. WOC in STEM do not have a community to turn to in this white male-dominated space and find that their gender compounded with their race excludes them even further outside the circle than their white female peers. In a 2014 survey of African American female students about their STEM pipeline experiences, "one participant explained, 'It's not just a racial issue but also an issue of sex. Females in science not only have to deal with sexism but also overt sexual harassment

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[65] Bryan A. Brown, J. B. Henderson, Salina Gray, Brian Donovan, Shayna Sullivan, Alexis Patterson, and William Waggstaff. "From Description to Explanation: An Empirical Exploration of the African-American Pipeline Problem in STEM." *Journal of Research in Science Teaching* 53, no. 1 (01, 2016): 174.
[66] Danyelle T. Ireland, et al. "(Un)Hidden Figures: A Synthesis of Research Examining the Intersectional Experiences of Black Women and Girls in STEM Education." Review of Research in Education, vol. 42, no. 1, Mar. 2018, 227.
[67] Ibid.

regularly.'"[68] As they lack any social currency with the scientific community, WOC have few places to turn for kinship within science culture. As a result, they "must either adjust to those norms or experience greater disengagement, experiences with racism, and feelings of isolation as a component of their academic experience."[69] These norms include daily racial and misogynistic microaggressions in the classroom, laboratory, and workspace. The constant microaggressions women of color face build psychological barriers that affect confidence and morale. "If one experienced microaggressions, an individual may begin to feel like an outsider, or misaligned with the science community."[70]

As the "other," women of color, specifically Black women, can feel overlooked for jobs and mentorships within the scientific community.[71] "In addition to feelings of isolation, Black women have expressed a sense of discouragement in STEM programs fostered by unfulfilled promises regarding academic opportunities, independence, and opportunities to be involved."[72] Whether completely invisible or too visible, the extremes of visibility Black women feel in STEM do not afford them more opportunities for mentorship or research or increase their career advancement chances. Their otherness only colludes to perpetuate their outsider status in the scientific community. Eventually, women of color, tired of the lack of acknowledgment, disengage from the science community entirely because they are no longer willing to be excluded from a group of people that refuses to empathize with them. This disengagement

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[68] Bryan A. Brown, J. Bryan Henderson, Salina Gray, Brian Donovan, Shayna Sullivan, Alexis Patterson, and William Waggstaff. "From Description to Explanation: An Empirical Exploration of the African-American Pipeline Problem in STEM." *Journal of Research in Science Teaching* 53, no. 1 (2016): 167.
[69] Ibid, 174.
[70] Ibid, 171.
[71] LaVar J. Charleston, Ryan P. Adserias, Nicole M. Lang, and Jerlando F. L. Jackson. "Intersectionality and STEM: The Role of Race and Gender in the Academic Pursuits of African American Women in STEM." *Journal of Progressive Policy and Practice* 2, no. 3 (2014): 277
[72] Danyelle T. Ireland, et al. "(Un)Hidden Figures: A Synthesis of Research Examining the Intersectional Experiences of Black Women and Girls in STEM Education." Review of Research in Education, vol. 42, no. 1, Mar. 2018, 240.

breaking point is where the STEM pipeline's leakage occurs for many Black women and women of color. Women of color resign to escaping the STEM pipeline to regain their self-identity as both a minority and a woman.

Historically black colleges and universities (HBCUs) have a STEM pipeline model that uses an intersectional lens, and through it, we see a thriving community of Black female scientists. HBCUs have put out above-average numbers in terms of STEM students of color. "Although only 6% of all African-American college students are enrolled at HBCUs, 28.8% of all African-American students who earn bachelor's degrees in science graduate from an HBCU."[73] This excellence is also seen on the graduate level as HBCUs produce more Black graduates receiving doctorates than private white institutions (PWIs). According to a 2013 National Science Foundation report and the Integrated Postsecondary Education Data System (IPEDS), of the top fifty institutions to produce Black graduates, "HBCUs collectively produced 1,819 Black graduates who earned a doctorate in S&E" while "PWIs produced 1,600 Black graduates."[74] These high graduation rates in STEM for Black students are not due to HBCUs merely having a more robust black student body. Schools with larger black populations than most HBCUs, like Georgia State University, Troy University, and the University of Memphis, did not make the top fifty list.[75]

What is taking place on HBCU campuses that propels Black students through the STEM pipeline at higher rates? HBCUs create a sense of community for Black students that supports them on their path towards academic success. One explanation for the black academic

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[73] Bryan A. Brown, J. Bryan Henderson, Salina Gray, Brian Donovan, Shayna Sullivan, Alexis Patterson, and William Waggstaff. "From Description to Explanation: An Empirical Exploration of the African-American Pipeline Problem in STEM." *Journal of Research in Science Teaching* 53, no. 1 (2016): 147.
[74] Ivory A. Toldson "Why Historically Black Colleges and Universities are Successful with Graduating Black Baccalaureate Students Who Subsequently Earn Doctorates in STEM (Editor's Commentary)." *The Journal of Negro Education* 87, no. 2 (2018): 95.
[75] Ibid.

achievement in STEM seen at HBCUs is their science programs' openness to the different educational journeys that Black students and other students of color experience. "Several unique components of the HBCU STEM learning environment include: assessing prior academic performance; facilitating college adjustment; social integration; and academic socialization."[76] Through these measures, HBCUs recommend learning strategies to Black students and adjust from high school to college. While HBCUs are nominally known to serve underrepresented racial groups, they also work with subgroups like community college transfer students and low-income students who are often under-supported at other institutions. Since "HBCUs educate a cross-section of STEM students, including first-generation college students and community college transfers,"[77] they have systems in place to help these groups with any issues they may face along the STEM pipeline. The final factor HBCUs possess for aiding students along the STEM pipeline is identity recognition. Supported by a faculty and staff with a shared cultural background, Black students feel accepted by the scientific community cultivated at an HBCU. The ability to see one's self or one's future self when looking at a professor or a peer is invaluable in the STEM experience because it is not possible to go through this journey feeling alone. A support system of those who empathize with students' unique experiences is necessary throughout their entire education. These ideas of community support and self-identity prove to be paramount in Black feminism.

[76] Ivory A. Toldson "Why Historically Black Colleges and Universities are Successful with Graduating Black Baccalaureate Students Who Subsequently Earn Doctorates in STEM (Editor's Commentary)." *The Journal of Negro Education* 87, no. 2 (2018): 96.
[77] Ibid.

Chapter 4: Black Feminist Theory and the Importance of Self-Identity in STEM

Black feminism, popularized in the 1990s, was a response to the slow ostracization of Black women from the feminist movement and the black power movements of the early 1970s.[78] This isolation led to the subsequent development and practice of black feminist theory and black feminist activism. Stemming from Black intellectuals' ideas and lived experience, black feminist theory tells the story of Black women collectively living under two pillars of oppression: race and gender. These Black intellectuals were not only made up of Black professionals or those in higher education, but they also included everyday women whose recorded experiences are a touchstone of the movement. Speeches and writing from Black female intellectuals like Sojourner Truth, Audre Lorde, Angela Davis, Kimberlé Crenshaw, Patricia Hill Collins and more, chronicled black feminist literature and encapsulated the long history of societal oppression of Black women in the United States. Collins defines black feminist theory as the "dialectic of oppression and activism, the tension between the suppression of African-American women's ideas, and our intellectual activism in the face of that suppression."[79] The interconnected nature of Black women's livelihood, otherwise known as the double bind, is central to the argument that Black women need distinct support in a world designed against them.[80]

Some key terms essential to understanding black feminist theory include a matrix of domination and intersectionality. "The term matrix of domination describes this overall social

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[78] Michelle Wallace. “A Black Feminist’s Search for Sisterhood,” in *All the Women Are White, All the Blacks Are Men, but Some of Us Are Brave: Black Women’s Studies*. Edited by Hull, Akasha Gloria, Patricia Bell-Scott, Barbara Smith, Brittney C. Cooper, and Mary Frances. Berry. New York City: Feminist Press at the City University of New York, 2015.

[79] Patricia Hill Collins, *Black Feminist Thought: Knowledge, Consciousness, and the Politics of Empowerment* (New York: Routledge, 2015), 3.

[80] Maria Ong et al., "Inside the Double Bind: A Synthesis of Empirical Research on Undergraduate and Graduate Women of Color in Science, Technology, Engineering, and Mathematics," *Harvard Educational Review* 81, no. 2 (2011): 174.

organization within which intersecting oppressions originate" and develop.[81] Acknowledging intersectional oppression is the first step in identifying the problems black feminist theory is attempting to highlight. Since these "large-scale, interlocking social institutions"[82] (politics, housing, education, voting rights, etc.) are intrinsically bound, inequity in one leads to injustice in most if not all of them. This injustice is real for Black women, who experience the discrimination of these systems from multiple angles of race, class, and gender. This matrix is an ever-changing space for how people are oppressed shifts with time, politics, and legal action. The matrix of domination in the 1950s, such as the segregation of public places, and blatant voter suppression, is different from today's matrix of de facto segregation through "color-blind" housing, education, and other political systems.[83] By this measure, "racial segregation persists, but not in the forms that it took in prior historical eras - so the shape of domination itself changes."[84] One could assume that the matrix of domination "now provides equal treatment because it perpetuated discrimination by race and gender"[85] is now illegal. Despite the legal precedents, the oppressed's issues continue because interconnected systems were made with racist, misogynist, and classist frameworks and were never restructured to uplift those who previously faced discrimination. This de facto segregation results in the oppression of vulnerable groups by supposedly invisible forces.

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[81] Maria Ong et al., "Inside the Double Bind: A Synthesis of Empirical Research on Undergraduate and Graduate Women of Color in Science, Technology, Engineering, and Mathematics," *Harvard Educational Review* 81, no. 2 (2011): 227.
[82] Patricia Hill Collins, *Black Feminist Thought: Knowledge, Consciousness, and the Politics of Empowerment* (New York: Routledge, 2015), 276.
[83] Michael K. Brown. *Whitewashing Race: The Myth of a Color-Blind Society*. 1st ed. Berkeley: University of California Press, 2003.
[84] Patricia Hill Collins, *Black Feminist Thought: Knowledge, Consciousness, and the Politics of Empowerment* (New York: Routledge, 2015), 228.
[85] Ibid, 279.

Intersectionality is a central facet to black feminism that interprets the vulnerability Black women face due to their double-bind identity. "Intersectionality refers to particular forms of intersecting oppressions," such as "intersections of race and gender, or of sexuality and nation."[86] Crenshaw first used the term intersectionality in employment discrimination cases where Black women could not find employment.[87] Although the Civil Rights Act of 1964 made strides towards dismantling oppressive structures that used discriminatory hiring practices based on race, class, and gender, it did not predict its implications for those that fall into multiple groups. Black women were unable to defend themselves on both counts of race and gender in employment disputes. The courts deemed it unfair for women of color to have two causes of action in a suit, where typically other groups only had one, race or gender.

Intersectionality currently examines Black women's and other women of color's struggles in multiple contexts. For example, intersectionality plays an essential role in feminism to highlight that the types of agendas being pushed forward by the movement tend to fall in line with white feminism. The feminist movement's pattern to solely focus on gender rather than take an intersectional feminist approach reinforces oppressive policies that exclude women of color. "When feminism and racism are non-intersectional [...] they often wind up reinforcing each other. They're not just neutral with respect to racism or neutral with respect to patriarchy; they end up reinforcing them."[88] Having an intersectional lens is essential when discussing black feminist activism because "these consequences are often invisible to the naked eye."[89] At first,

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[86] Rebecca Epstein, Jamilia J. Blake and Thalia González. (2017). Girlhood interrupted: The erasure of Black girls' childhood. Center on Poverty and Inequality, 18.
[87] Kimberle Crenshaw. "Demarginalizing the Intersection of Race and Sex: A Black Feminist Critique of Antidiscrimination Doctrine, Feminist Theory and Antiracist Politics," University of Chicago Legal Forum: Vol. 1989: Iss. 1, Article 8.
[88] "Kimberlé Crenshaw - On Intersectionality - Keynote - WOW 2016," YouTube, March 14, 2016, https://www.youtube.com/watch?v=-dw4hlgypla)
[89] Ibid.

one might not see subsidized housing, education equality, or voter suppression as a gender or race issue. However, with an intersectional lens, we see these issues are relevant from a race and gender perspective, Black women are demonstratively affected, and these invisible systems stop Black women from receiving fundamental human rights.

Black feminist theory proposes a paradigmatic shift in power regarding intersectional oppression by rejecting white supremacist notions and uplifting the voices of vulnerable groups suppressed by intersectional oppression in the United States. Within the matrix of domination, different forms of oppression combine to further the injustices on vulnerable populations like women, minorities, and the lower-class. "Intersectional paradigms remind us that oppressions work together in producing injustice."[90] While the matrix of domination explains the organization of social systems at any given moment in time, the intersectional oppression paradigm demonstrates how the connections between societal systems collude to suppress non-white female citizens' rights and give white males more political power. However, black feminist theory dictates that this power dynamic does not have to reign true. In fact, "black feminist thought fosters a fundamental paradigmatic shift in how we think about unjust power relations. By embracing a paradigm of intersecting oppressions of race, class, gender, sexuality, and nation, [...] Black feminist thought reconceptualizes the social relations of domination and resistance."[91] Traditionally, vulnerable groups do not have much power within the matrix of domination, but they have more commonality and knowledge when combined. The shared experiences of vulnerable groups of color unite and empower them more than the current

[90] Patricia Hill Collins, *Black Feminist Thought: Knowledge, Consciousness, and the Politics of Empowerment* (New York: Routledge, 2015), 18.
[91] Ibid, 273.

structure supports them. Therefore, black feminist theory, while it stems from Black women's issues, ideologically supports all vulnerable groups against white supremacist structures.

In rejecting the current power dynamics, Black women are found in an uncomfortable position as the “outsider-within” individual socio-political spaces but prove resilient once connected to others similarly positioned. Modern Black women find themselves excluded from institutions they fought so hard to get into, even when equipped with more rights than ever before. At work, school, and in academia, Black women still find themselves as outsiders.[92] As we have seen in Black female STEM students and scientists' personal experiences, there is an isolation that comes with being a Black working professional. Once in a role of power, Black women "have a hard time pointing to the source of their alienation and depression or clearly identifying with a base"[93] both in and outside their communities. There is a fear of becoming disengaged from both communities, the Black community and the community of social mobility and capital. This exclusion occurs because these institutions that provide social mobility were founded under a white male consciousness resulting in the "elevation of elite white male ideas and interests and the corresponding suppression of Black women's ideas and interests."[94] Being an outsider is not singular; vulnerable, oppressed groups universally feel it. By linking with fellow outsiders-within these white male-dominated spaces, Black women can begin "building effective coalitions and stimulating dialogue with others who"[95] want true human equality.

Through black feminist theory, women of color support one another in their mission to extend human rights to all vulnerable groups. "Black feminist thought's identity as a 'critical'

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[92] Susan E. Martin. “‘Outsider Within’ the Station House: The Impact of Race and Gender on Black Women Police.” *Social Problems* 41, no. 3 (1994).
[93] Patricia Hill Collins, *Black Feminist Thought: Knowledge, Consciousness, and the Politics of Empowerment* (New York: Routledge, 2015), 66.
[94] Ibid, 5.
[95] Ibid, 38.

social theory lies in its commitment to justice, both for U.S. Black women as a collectivity and for that of other similarly oppressed groups."[96] As demonstrated earlier, no single individual experiences intersectional oppression alone. There are infinite combinations of underrepresented groups by race, class, gender, and sexuality that go unseen in public policy and lawmaking. Unfortunately, the white political majority excludes many vulnerable groups from the conversation. But by implementing black feminist thought in the blueprint for the human rights movement, these groups can come together to tackle "a much larger social justice project that goes far beyond the experiences of African-American women."[97] While black feminist theory may have started with Black women's ideas and experiences, it does not end there. "The importance of Black women's leadership in producing Black feminist thought does not mean that others cannot participate."[98] Black feminist theory's role is to help uplift all vulnerable groups and seek social justice for all said groups.

As black feminist theory works to help multiple vulnerable groups, it is essential to harken back to its origin and reflect on the identity of those who created it because, for Black women, part of the journey to empowerment comes from defining oneself. "When Black women value our self-definitions, [...] and invoke Black feminist epistemologies as central to our worldviews, we empower ourselves."[99] Self-identity is crucial for Black women, especially in newfound positions of power in typically white social systems. The connection of self to science was a good indicator for middle school girls' interest in STEM, and self-identity remains important as Black girls grow to become Black women.[100] "Black women intellectuals from all

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[96] Patricia Hill Collins, *Black Feminist Thought: Knowledge, Consciousness, and the Politics of Empowerment* (New York: Routledge, 2015), 9.
[97] Ibid, 18-19.
[98] Ibid, 35.
[99] Ibid, 289.
[100] Brickhouse, N. W., Lowert, P., & Schultz, K. (2000). What kind of girl does science? The construction of school science identities. *Journal of Research in Science Teaching, 37*, 441-458.

walks of life must aggressively push the theme of self-definition because speaking for oneself and crafting one's agenda is essential to empowerment."[101] It must be made explicitly clear that Black women define themselves for the sake of their empowerment. While the black feminist framework can aid multiple oppressed groups, it does not mean other people can define black feminism for Black women. "It does mean that the primary responsibility for defining one's own reality lies with the people who live that reality, who actually have those experiences."[102] Relinquishing the power of self-definition is not an option for Black women because they have historically lost that power through slavery and refuse to go back to a time where lack of self-definition left them defined as property. "Because self-definition is key to individual and group empowerment, ceding the power of self-definition to other groups, no matter how well-meaning or supportive of Black women they may be, in essence, replicates existing power hierarchies."[103] Self-definition is an empowering tool Black women cultivate from an early age to secure human rights like educational equality.

An example of self-definition in STEM for Black girls comes in the study "Crafting a Future in Science: Tracing Middle School Girls' Identity Work Over Time and Space," which followed two Black middle school girls Diane and Chantelle, in science from seventh to eighth grade. Focusing on Diane's journey, we see that she did not see herself as a "good science student" despite a deep understanding of the material and being a member of her school's science club. In a self-portrait titled Diane in science, Diane "drew herself as a scientist doing an experiment in seventh grade and as a student sitting quietly at her desk in eighth grade."[104] Diane

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[101] Patricia Hill Collins, *Black Feminist Thought: Knowledge, Consciousness, and the Politics of Empowerment* (New York: Routledge, 2015), 36.
[102] Ibid, 45.
[103] Ibid, 36.
[104] Barton, Angela Calabrese, Hosun Kang, Edna Tan, Tara B. O'Neill, Juanita Bautista-Guerra, and Caitlin Brecklin. "Crafting a Future in Science: Tracing Middle School Girls' Identity Work Over Time and Space." American Educational Research Journal 50, no. 1 (2013): 49.

also demonstrated her waning interest in science from seventh to eighth grade as she ranked herself as a 4 out of 7 science student in seventh grade compared to her ranking the following year of 2 out of 7.[105] The question remains, why did Diane think she was a "bad science student"?

Diane believed she was not a good science student because the education system's structural limitations prevented her teachers and peers from recognizing her ability and, in turn, diminished her potential self-identity within science. Diane experienced multiple events over the two years that lowered her interest in STEM. The first dilemma was with Diane's invasive species poster. Diane typically took a long time to complete assignments as she was very invested in the research component of most projects. But since she turned in the poster late and incomplete according to the assignment's rubric, "the teacher perceived [it as] her lackluster ability in science class."[106] However, this poster showed Diane's budding interest in science because of her further exploration of the topic outside the rubric's requirements. Other "top science students" in the class could not recall anything specific about invasive species after turning in their posters. Diane, on the other hand, "explained in depth the different invasive species, the role they played in changing the lake ecology, and how they got there." [107]

Another issue came to fruition when Diane left the Science Club. In seventh grade, Diane joined the science club with a diverse mix of students, "10 girls – 5 White, 3 African American (including Diane), and 2 Asian girls, all with various school performance levels and family background. […] However, as time went by, the club became dominated by middle-class White

[105] Barton, Angela Calabrese, Hosun Kang, Edna Tan, Tara B. O'Neill, Juanita Bautista-Guerra, and Caitlin Brecklin. "Crafting a Future in Science: Tracing Middle School Girls' Identity Work Over Time and Space." American Educational Research Journal 50, no. 1 (2013): 54.
[106] Ibid, 68.
[107] Ibid, 39.

girls who began to bring their friends into the club."[108] This increase in white female students typically would not present an issue. However, after Diane's friend transferred to a different school and more Black girls left the science club, Diane weighed her options and decided that hanging out with her friends during lunch was more important than science club attendance. She said, "that her close friends, who were all African American, wanted her to stay with them at the cafeteria during lunchtime […] one of the few times during the school day she saw her friends, as most were in other sections."[109]

Diane's middle school science class experience is not individual and patterns many girls' entry and exit from the STEM pipeline. While Diane exhibited promise with her detailed research in her invasive species poster and membership in the science club, rigid educational and racial structures pushed her out of contention to be a "good science student." "Diane, despite her best efforts to engage in science for meaningful learning, was consistently positioned as slow and as not caring about school success in normative terms, […] they valued expediency and getting it right over slower, more purposeful efforts to think about the science at hand."[110] Diane could not self-identify as a good science student because the parameters to become one were not inclusive to her performance and how she best learned. "The institutional narrative hid Diane's engagement with science regarding the good science student (finishing work quickly and efficiently, often with high grades) and further laminated by racialized power dynamics that forced choice between friendship and science." [111] Diane's story shows how student trajectory in

[108] Barton, Angela Calabrese, Hosun Kang, Edna Tan, Tara B. O'Neill, Juanita Bautista-Guerra, and Caitlin Brecklin. "Crafting a Future in Science: Tracing Middle School Girls' Identity Work Over Time and Space." American Educational Research Journal 50, no. 1 (2013): 51.
[109] Ibid, 51.
[110] Ibid, 64.
[111] Ibid, 73.

STEM can quickly change over a few years because of failing to acknowledge the barriers black girls face in education and refusing to bend the rules to include them.

Black girls, unfortunately, face many obstacles in their journey of self-definition during their middle school years because of adultification, which results in disproportionately excessive punishments for black girls compared to that of white girls. A 2017 Georgetown University study revealed that adultification, "the perception of Black girls as less innocent and more adult-like than white girls of the same age,"[112] significantly impacts the severity of school's disciplinary actions towards black girls. The study surveyed 325 participants and asked them questions on childhood development for either black girls or white girls. Results showed that adultification of black girls begin early, at age 5, and peaked between 10 and 14.[113] These results are significant because they demonstrate how black girls receive adult punishments during what is supposed to be their childhoods. They are not allowed to make mistakes without receiving harsh penalties; they are ignored in the classroom and receive fewer leadership opportunities.

Unfortunately, the effects of adultification present themselves prominently in Black girls' suspension and expulsion rates, which result in more juvenile detention arrests. From a report from the National Women's Law Center, Black girls are 5.5 times more likely to be suspended from school than white girls.[114] Suspensions take away valuable in-school time from Black girls, and one suspension leads to a higher chance of more disciplinary action in the future. Black girls are 6.1 times more likely to be expelled and 2.5 times more likely to be expelled without educational services than white girls.[115] Extreme out-of-school punishments cause a slippery

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[112] Rebecca Epstein, Jamilia J. Blake and Thalia González. (2017). Girlhood interrupted: The erasure of Black girls' childhood. Center on Poverty and Inequality, 1.
[113] Ibid, 8.
[114] Adaku Onyeka-Crawford, Kayla Patrick, and Neena Chaudhry. *Let Her Learn: Stopping School Pushout for Girls of Color*. National Women's Law Center, 1.
[115] Ibid, 14.

slope for girls of color and push them off the path towards higher education and into one of crime. Black girls represent 28.2% of girls referred to law enforcement and 37.3% of girls arrested even though they make up 15.6% of the student population in the U.S.[116] These percentages represent the dismal trend of the school-to-prison pipeline, "a disturbing national trend wherein children are funneled out of public schools and into the juvenile and criminal justice systems."[117] The adultification of Black girls, at its worse, steers Black girls away from the STEM pipeline and diverts them into the school-to-prison pipeline.

Black feminist theory is an excellent framework for assessing why there are so few Black women in STEM. It details the importance of intersectionality and why examining societal problems from the overlapping race, gender, and class perspectives draw out how invisible forces continue to uphold oppressive systems. Black feminism also unites vulnerable groups by comparing their collective struggles, seeing the similarities in their oppression, and fighting for equal human rights. We can use black feminist theory to highlight intersectional issues such as the suspension and expulsion rates of Black girls in the U.S. and provide context like the bias of adultification to explain why such trends occur. Black feminist theory illuminates the problems women of color face in STEM, and it provides the framework for possible solutions like STEM programming.

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[116] Leticia Smith-Evans, Janel George, Fatima Goss Graves, Lara S. Kaufmann, and Lauren Frohlich. *Unlocking Opportunity for African American Girls: A Call to Action for Educational Equity*. NAACP Legal Defense & Educational Fund (LDF), The National Women's Law Center, 2014, 16.

[117] "School-to-Prison Pipeline." American Civil Liberties Union. https://www.aclu.org/issues/juvenile-justice/school-prison-pipeline.

Chapter 5: The MESA Program

One solution to the issue of diversity in STEM is the creation of minority-focused STEM programming. Many programs address students of color; however, only a few genuinely succeed in providing them with degrees and long-lasting careers, and even fewer do so in the sciences. The MESA Program is one such revolutionary program that is described as "a cooperative effort by secondary and postsecondary education institutions, working with private industry, to increase the number of students from low-income and ethnic minority backgrounds […] gain employment in engineering, mathematics, and science-related professions in California."[118] What makes the MESA Program different from other minority-focused STEM programming is its foundation on social justice and the close-knit cultural community it creates at every school. Although California's Proposition 209 in 1996 prohibited affirmative action programs in the public education system, the MESA Program continues to use an intersectional lens to identify what disadvantaged students need and implement programming tailored to their experiences.[119] Doing so makes a program that stands outside of the traditional pipeline model to get vulnerable groups to move on to higher education and career success within STEM they otherwise might not attain on their own.

The Civil Rights Movement, the Women's Rights Movement, and the Black Power Movement, amongst other historical movements, contributed to the MESA program's racial and political underbelly. After the Civil Rights Act passed in 1964, U.S. employers could not discriminate against employees based on race, class, and gender.[120] With these new employment

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[118] The Role of the California Postsecondary Education Commission in Achieving Educational Equity in California: The Report of the Commission's Special Committee on Educational Equity. Commission Report 88-31. (1988), 29.
[119] Proposition 209: Prohibition Against Discrimination or Preferential Treatment by State and Other Public Entities. Accessed December 18, 2020. https://lao.ca.gov/ballot/1996/prop209_11_1996.html.
[120] "Legal Highlight: The Civil Rights Act of 1964." U.S. Department of Labor Seal. https://www.dol.gov/agencies/oasam/civil-rights-center/statutes/civil-rights-act-of-1964#:~:text=The Civil Rights

jurisdictions, many industries needed to diversify their applicant pool. The U.S. scientific community also felt these changes, and the central problem science and tech companies faced moving forward were locating more diverse applicants. In turn, this change in hiring policy motivated industry recruiters to seek out skilled minority graduates in STEM at colleges as they questioned "university professors about the dearth of qualified minorities, particularly African-American, Mexican-American, Native-American, and Puerto Rican graduates."[121] Once industry executives discovered the low number of U.S. minority students graduating in science and engineering, some companies began to inquire about skilled labor abroad rather than look domestically. One could argue that because high school and college education systems segregated students for so long, the number of qualified minority students with the proper education background was too low to create a more diverse applicant pool. However, I argue that oppressive educational systems prevented students of color at the time from being interested in STEM and pursuing STEM degrees. Programs like the MESA Program and its forefather, the Educational Opportunity Program, circumvent these oppressive systems and push minority students through to STEM careers.

One program that began to address the lack of diversity on college campuses was the Educational Opportunity Program (EOP) at the University of California Berkeley (UCB). After a faculty committee studied the low number of minority groups entering UCB, special assistant Bill Somerville addressed the school's diversity issue and created a solution. In 1966, Somerville visited 120 high schools and recruited minority students for the College Commitment Program,

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Act of 1964 prohibits discrimination on the,religion, sex or national origin.&text=The Act prohibited discrimination in,and the desegregation of schools.

[121] Wilbur H. Somerton. *The MESA Way: A Success Story of Nurturing Minorities for Math/science-based Careers*. San Francisco, CA: Caddo Gap Press, 1994, 13.

which eventually became the EOP.[122] From 1966-1968 the EOP recruited over 1000 students to enroll in UCB.[123] Even though the EOP increased the number of minority students at UCB, it still failed to increase the number of minority students graduating with degrees in the sciences. Bill Somerton, an engineering professor at UCB, noticed this issue within the engineering program and EOP after being told by recruiters about the necessity for more minority engineering graduates. After going to the EOP for solutions, Somerton discovered that “less than 1 percent of the engineering graduates came from underrepresented minority groups,"[124] and "99 out of 100 African American students enrolled in social science courses for majors in social welfare-type programs."[125] So while the overall number of minority graduates at UCB increased with the creation of the EOP, the number of students of color completing science degrees remained nonexistent. One explanation for this number disparity was the pre-college education required to enroll in the introductory science courses necessary for an engineering degree or any STEM degree. The minority students who enrolled through the EOP program, while they "met the minimum admission requirements, by and large [...] lacked [the] high school preparation to enter math-based fields of study."[126] Some were told directly by high school guidance counselors to avoid "courses in advanced mathematics and science,” and these counselors suggested, “that the inevitable C's and D's, which would jeopardize their university admission opportunities."[127] At the hands of a discriminatory education system, students of color, trusting the advice from members of the school system built against them, were turned away from pursuing STEM courses early in their education and subsequently were locked out of a future in STEM.

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[122] Wilbur H. Somerton. *The MESA Way: A Success Story of Nurturing Minorities for Math/science-based Careers*. San Francisco, CA: Caddo Gap Press, 1994, 14.
[123] Ibid, 14.
[124] Ibid, 18.
[125] Ibid, 14.
[126] Ibid, 18.
[127] Ibid.

In collaboration with the EOP, Bill Somerton created the math and science-focused program, Mathematics, Engineering, Science Achievement (MESA) Program, in 1970 to increase the number of minority engineering graduates. The program's general structure was the brainchild of Beth Cobb, a Berkley resident who volunteered with the EOP in 1967. She participated in minority youth outreach as an administrator of the Morabito 49er Scholarship Program and transferred this experience to MESA.[128] While at EOP, Cobb proposed the Incentive Scholarship Program that contained vital elements of MESA, such as providing financial rewards to students and taking them on field trips to places like the Federal Power Commission and General Electric. Bill Somerton tailored Beth Cobb's math and science-focused programming model and implemented certain elements such as field trips and monetary incentives in MESA. Early participants came up with the name Mathematics, Engineering, Science Achievement Awards Program, which turned into the acronym MESSUP and eventually became MESA.[129]

Now secured with a name, they needed a clear mission, and MESA's mission is to support minority students through the STEM pipeline by helping them "complete their preparatory requirements, gain admission, then earn their university or college degrees."[130] This mission rides on the assumption that "minority students could excel," and this program can stimulate students to do so.[131] While today, most educators would not question the academic ability of minority students, we must remember the zeitgeist of the time of founding the program was one of overt racial discrimination. The assumption at the time was that Black students were

[128] Wilbur H. Somerton. *The MESA Way: A Success Story of Nurturing Minorities for Math/science-based Careers*. San Francisco, CA: Caddo Gap Press, 1994, 15.
[129] Ibid, 16.
[130] Ibid, 2.
[131] Ibid, 49.

inferior and less intelligent compared to white students.[132] Black students would be discriminated against and assumed to be incapable of the academic rigor required to get into college and graduate with a STEM degree. With this assumption in mind, the program scouted for its first pilot school amidst a volatile political climate.

In 1969, the MESA program chose the Oakland Technical High School for its pilot program because of its history with social justice and the student body's active participation in curriculum decisions. Oakland Tech is in Oakland, California, less than three miles from UCB's Lawrence Hall of Science. A sizeable number of Tech students graduated from UCB, and it served as the location for UCB's School of Education high school summer program.[133] With this standing history with UCB, Oakland Technical High School was already a viable option for the MESA Program. However, a more telling story begins to present itself once we look further into the school's and student body's history, one of white flight and an increased minority population.

At the beginning of the 1960s, "more than 60 percent of Oakland Technical High School's graduating seniors were white," but by the end of the decade, "Tech's graduating class was less than 15 percent white" in 1969 due to white flight.[134] White flight was a rampant epidemic amongst inner-city neighborhoods used to maintain wealth within white communities. White families would uproot and move from one town to another, typically from inner-city neighborhoods to the suburban townships, once black neighbors began moving in. For example, following the assassination of Martin Luther King Jr. on April 28. 1968, students at Oakland Tech staged an unplanned walkout that destroyed school property and injured some students.[135]

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[132] Leah Platt Boustan. "Was Postwar Suburbanization "White Flight"? Evidence from the Black Migration." *The Quarterly Journal of Economics* 125, no. 1 (2010).
[133] Wilbur H. Somerton. *The MESA Way: A Success Story of Nurturing Minorities for Math/science-based Careers*. San Francisco, CA: Caddo Gap Press, 1994, 23.
[134] Ibid, 21.
[135] Ibid, 22.

White parents responded by pulling their kids from school and moving to another school district the following summer. Unfortunately, white flight's effects are felt most heavily on the minority students left in lower-income school districts. The MESA Program would come to Oakland Technical High to raise its expectations.

Given this taste of political expression, it is no surprise that students at Oakland Tech were very vocal about their education. On January 23, 1969, the Oakland Tech student newspaper, The Scribe, published a list of demands from six Oakland high schools, originally presented at a board of education meeting. Their demands were as follows:

> 1) Re-educate teachers, counselors, and administration and sensitize them to the needs of African-American, Mexican-American, Native-American, and Asian-American students.
>
> 2) Integrate minority history into required social studies, rather than optional, elective courses.
>
> 3) Make sure textbooks relate to the needs of minorities.[136]

These demands demonstrate how Oakland Tech students knew that race should play a role in their education and curriculum development. The MESA program chose Oakland Technical High School for MESA's pilot program for multiple practical reasons such as location and previous history with UCB as well as more political ones such as social justice leanings and racial makeup of the student body. Ultimately, Oakland Tech's student body showed their tenacity through their persistence to define their education for themselves and solidified their spot as the first school to be a part of the MESA Program.

After Bill Somerville interviewed Mary Perry Smith and some Oakland Tech students in the spring of 1969, she became the MESA Program's first advisor. Smith's role was "to start a

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[136] Wilbur H. Somerton. *The MESA Way: A Success Story of Nurturing Minorities for Math/science-based Careers*. San Francisco, CA: Caddo Gap Press, 1994, 22.

pilot program, see if it helped our students, and to suggest any changes that would bring about positive results."[137] Since she was the direct communication line from Oakland Technical High School to the MESA Program, she selected the first twenty-five students to participate. Once Smith chose the students, they collaborated with school faculty and MESA staff to develop the program. MESA wanted students "to help develop and refine the program. Student representatives brought their ideas and aired grievances before the Steering Committee."[138] This student involvement echoes the Oakland Tech students' vocality in 1969, who demanded inclusion when developing their high school curriculum. Their active participation in their educational system impacted the structure of the MESA program.

When viewed through an intersectional lens, we can see how the five components of the MESA Program (tutoring, counseling, field trips, incentives, and summer employment) effectively targeted the needs of minority students and promoted their interest in STEM. Alongside a full curriculum of geometry, trigonometry, pre-calculus, chemistry, English, MESA created a cultural support system their students turned to for guidance. Tutoring for the MESA Program included tutors ranging from MESA alumni, college students, and advanced MESA students, most of whom were students of color. MESA Advisors, math and science teachers at a respective school, provide academic advising to students. In these counseling sessions, MESA advisors informed students on pre-college requisites, helped them develop career goals, and matched them with colleges and universities that meshed with their interests. Field trips exposed students to different job possibilities and college choices they might not have considered otherwise. "During MESA's first years, Somerton, using his industry contacts, scheduled field

[137] Wilbur H. Somerton. *The MESA Way: A Success Story of Nurturing Minorities for Math/science-based Careers*. San Francisco, CA: Caddo Gap Press, 1994, 24.
[138] Ibid, 27.

trips that put students in touch with the engineering and scientific work corporate America conducts."[139] MESA students went to engineering plants and the offices of H.P. and Exxon Mobil to learn about what the industry had to offer them in the future. "Field trips gave students an inside look at how the corporate world functions, how engineers, mathematicians, and scientists perform their jobs, and some advantages and disadvantages of working in the industry."[140] Seeing STEM career professionals that were women, people of color, etc., through the MESA program impacted students' sense of self when it came to science and shifted students' perception of what a career in science looks like and who can become a scientist.

Although some may not agree with their implementation, financial incentives provide support to low-income minority students in a way that is conclusive to their experience. Incentive awards are given to students as cash or in opportunities to participate in supplementary program events. Monetary incentives range from $100 to $250 a year for senior high students who "earn at least two A's and a B in advanced math, science and English courses."[141] Another way students earn money through the program is by tutoring. "MESA students participated in the Math Department's regular after-school study sessions two afternoons each week," and they "could earn extra money by tutoring younger students."[142] Incentives were a divisive component of the program. Some have argued that students should not receive monetary incentives because it rewards them for something they should be doing regardless of getting good grades. However, the counterargument is that upper to middle-class parents give their children an allowance and other good grades. Therefore, if a parent cannot provide that type of financial support, a program

[139] Wilbur H. Somerton. *The MESA Way: A Success Story of Nurturing Minorities for Math/science-based Careers*. San Francisco, CA: Caddo Gap Press, 1994, 26-27.
[140] Ibid, 27.
[141] Ibid, 4.
[142] Ibid, 26.

can step.[143] Incentive awards will benefit the student by relieving that type of stress and potentially motivating them to earn higher grades. Summer employment opportunities are given to juniors and seniors in high school to earn a wage and gain work experience. "Most had never worked and lacked know-how on fitting into a technical workforce. They learned practical, scientific concepts that shed light on and clarified classroom tasks and discussions. Some kept those jobs throughout their college years; a few even stayed with their firms after graduation."[144] Providing minority students the opportunity to work in laboratories alongside STEM workers from different backgrounds reinforced their sense of self in science by showing what day to day life is like in a STEM career. Now that the program had a grip on high school programming, it was time to expand to junior high schools.

Expansion and the creation of Junior MESA opened the MESA program to include middle school, minority students. As MESA's first expansion project, Junior MESA was an essential step in the program's development because choosing to incorporate middle school students meant that the supportive STEM pathway for MESA students was consistent from junior high to high school to college. In 1972, Junior MESA launched in Woodrow Wilson Junior High.[145] The middle school expansion occurred at Woodrow Wilson because it was one of Oakland Technical High School's feeder schools. Since Oakland Tech matriculated students starting in the tenth grade, the MESA program needed to incorporate a school with ninth-graders for a complete high school program. An official pilot program for Junior MESA began in 1983 after a grant from the Carnegie Foundation and, Junior MESA fully launched in 1985.[146] The

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[143] Roland G. Fryer. "Financial Incentives and Student Achievement: Evidence from Randomized Trials." *The Quarterly Journal of Economics* 126, no. 4 (2011).
[144] Wilbur H. Somerton. *The MESA Way: A Success Story of Nurturing Minorities for Math/science-based Careers*. San Francisco, CA: Caddo Gap Press, 1994, 27.
[145] Ibid, 33.
[146] Evaluation of the Junior MESA Program: A Report to the Legislature in Response to Assembly Bill 610 (Hughes) of 1985 [Commission Report 89-30], 1989, 3.

goals of Junior MESA as stated in the 1985 California Assembly Bill 610 (Education Code Sections 8612-8618) include increasing "the pool of low-income and ethnic-minority students who complete junior high school prepared to embark upon a college preparatory high school program" and increasing "the number of low-income and ethnic-minority junior high school students who complete pre-algebra and pre-geometry courses."[147]

Another goal of Junior MESA was to create a sense of community among the students starting in middle school and continuing through high school and college. Establishing a MESA student community in which they could confide in each other and support one another through the process is crucial to the program's sentiments of high achievement and reaching long term goals. In the 1988-89 school year, the makeup of Junior MESA participants were 42.5% Black students, 51.3% Mexican-American students, 57.1% female students, and 42.9% male students shows a commitment to making this community diverse and inclusive.[148] A California Postsecondary Education Commission (CPEC) Report about Junior MESA, "students identified the program as important in peer support and individual encouragement."[149] Having this support network in this high-pressure environment helps push students past the point of doubt when they have peers who understand them by their side. "With others their age, MESA middle school students gather in study groups after school or at a summer session on a university campus. They discovered it's okay to be bright and earn good grades."[150] The completion rates of MESA students' advanced STEM subjects in their senior year compared to other California seniors shows the successful impact of this community support of the Junior MESA program. The

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[147] Wilbur H. Somerton. *The MESA Way: A Success Story of Nurturing Minorities for Math/science-based Careers*. San Francisco, CA: Caddo Gap Press, 1994, 135.
[148] Evaluation of the Junior MESA Program: A Report to the Legislature in Response to Assembly Bill 610 (Hughes) of 1985 [Commission Report 89-30], 1989, 6.
[149] Wilbur H. Somerton. *The MESA Way: A Success Story of Nurturing Minorities for Math/science-based Careers*. San Francisco, CA: Caddo Gap Press, 1994, 136.
[150] Ibid, 2.

completion rates in advanced mathematics for MESA seniors was 93.5% compared to Black seniors (6.8%), Hispanic seniors (6.8%), and California seniors (14.8%); 90.5% of MESA seniors completed the chemistry compared to Black seniors (35.7%), Hispanic seniors (29.7%) and California seniors (43.1%); and 78.7% of MESA seniors finished physics compared to Black seniors (9.8%), Hispanic seniors (8.2%), and California seniors (17.2%).[151]

The growth of the MESA program continued well into the early 1990s. "In 1992, the junior and senior high participants exceeded 11,000 in California," and the following year, 1,000 more students entered the program with the MESA Senior High Program reaching "nearly 7,000 and the program influenced another 5,000 youngsters in elementary and junior high school" in Junior MESA.[152] From 1970 through 1992, MESA "served more than 40,000 minority group students in 250 elementary, middle, and high schools" in California.[153] By 1993, "seventy-three percent of MESA's students enroll in four-year colleges or universities" compared to "only 13 percent of the total underrepresented minority students in California enroll."[154]

From its inception in 1970 to its fiftieth anniversary in 2020, the MESA Program has shown that students of any racial background can succeed in STEM through community support and industry ties. MESA currently serves over 49,000 students across 350 school districts in California, Arizona, New Mexico, Nevada, Oregon, Texas, Utah, and Washington.[155] The program now called MESA USA has streamlined into three offshoots: the MESA College Prep Program, for students K-12, the Transfer Program, for community college students, and the MESA University Program, for students attending a four-year college or university.[156] The

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[151] Evaluation of the Junior MESA Program: A Report to the Legislature in Response to Assembly Bill 610 (Hughes) of 1985 [Commission Report 89-30], 1989, 13.
[152] Ibid, 45.
[153] Ibid, 17.
[154] Ibid, 17.
[155] "About Us," MESA USA, August 11, 2020, https://mesausa.org/about-us/)
[156] "Programs." MESA USA. May 13, 2020. Accessed December 18, 2020. https://mesausa.org/programs/

National Science Foundation (NSF) featured the program as an innovator of change in STEM education. By paying close attention to students from an early age and following their unique pathways to STEM education, MESA continues to strive for the best for its students' futures. Hopefully, it will continue to do so for another fifty years.

Chapter 6: Conclusion

Black middle school girls are capable of STEM self-definition and succeeding in STEM when given tailored support through intersectional STEM programming. However, the world in which Black girls are born is not very promising for a future in STEM. Historically, from slavery to segregated public schools to de jure segregation, the education system set up Black girls to fail. Slavery banned people of color from any form of literacy; segregated schools emphasized Black students' false inferiority to teachers, and *Brown v. Board's* vague legalese inadvertently promoted de jure segregation within the U.S. education system.

The intersectional failings of the current education system amplify themselves in a STEM context. White males use the STEM pipeline, for instance, to navigate their way to a STEM career. However, minority students cannot take the same approach because the pipeline fails to consider how their unique background affects their ability to traverse this pathway. The advanced degree requirements for STEM careers present barriers for students of color in college, as shown by the low rates of Black female students receiving bachelor's degrees, master's degrees, and doctorates in STEM. Lastly, the scientific community does not lend itself to include women of color because of its original intentions to foster white male scientific thought.

Black feminist theory then works to identify these intersectional failings within STEM education and unites women of color in STEM through their shared experiences with the double bind. The double bind refers to how race, class, gender, and sexuality work to suppress vulnerable groups further. Intersectionality can be applied in multiple contexts and describes various vulnerable groups, not only Black women. For example, the term intersectionality, first used to help Black women facing employment discrimination, is used here to highlight women of color's STEM experiences. Isolation, disengagement, and lack of community are all problems

women of color in STEM face but viewed through an intersectional lens become more apparent. Self-definition is a tool Black women use to combat intersectional oppression. When started from a young age, self-identity can impact Black girls' career and life trajectory. I agree with Barton regarding the importance of self-identity for girls of color in STEM and that "without attention to how girls from nondominant backgrounds engage in identity work and the implementation of schoolwide efforts that support girls in challenging the traditional narrative of what it means to be a good science student, [...] any efforts to 'level the playing field' will not fully be met."[157]

Finally, STEM programming supports the continued development of Black middle school girls' self-identities with an intersectional framework. What it means to make a STEM program intersectional is that all choices, from the mission to the curriculum to the program's staff, deeply considers the lived experiences of vulnerable groups, like Black girls, who are at an intersection of race, class, and gender. The MESA Program has intersectional values in that it was social-justice-oriented from its founding in 1969 by partnering with the vocal student body of Oakland Technical High School. It incorporates the needs of students and communities of color from an early age (Junior MESA). It puts them on a pathway to future STEM careers outside the confines of the one size fits all model of the STEM pipeline. More long-term intersectional programming needs to be put into place to support Black girls on their journey to STEM careers and to increase the number of women of color in STEM overall.

[157] Barton, Angela Calabrese, Hosun Kang, Edna Tan, Tara B. O'Neill, Juanita Bautista-Guerra, and Caitlin Brecklin. "Crafting a Future in Science: Tracing Middle School Girls' Identity Work Over Time and Space." American Educational Research Journal 50, no. 1 (2013): 75.

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