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**RESEARCH ARTICLE**

# Teaching health justice and reimagining narratives of place through community-driven science practices

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**Abstract**

This study explores how a biology teacher from a summer science program engaged high school students of color in a three-week science unit exploring community health at the intersection of history, race, place, and power. The goal of this study is to better understand what community-driven science looks like in a science classroom when a health equity unit is guided by a biology teacher who engages the socio-historical, political, and relational aspects of community structure and agency. Using student and instructor interviews, program observations, and student artifacts, I examine how the instructor's positioning as a Black woman scientist shaped her goals and vision and the instructional and pedagogical resources made available during the unit. In addition, I explore how engaging in community-driven science practices during the unit such as critical inquiry and data analysis supported students' sense making about community health and the possibilities they imagined for their communities. Findings illuminate how engaging community health at the intersection of history, race, place, and power shaped engagement in community-driven science practices and supported student sense making in ways that surfaced

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challenges, tensions, and opportunities for disrupting and reimagining community narratives. Further, finding highlight the importance of an instructor's lived experiences and pedagogical vision in supporting emergent forms of student agency and place remaking, and generating possibilities for community healing and hope.

#### KEYWORDS

community health, justice-centered science, narratives, place, race, secondary science teaching

## 1 | INTRODUCTION

Racial, environmental, and science educational injustices are highly intertwined with direct implications for the health, well-being, and agency of communities of color (i.e., comprised of racial groups excluded from access and opportunity in society, school, and science). In her critique of an inequitably designed education system, scholar and journalist Nikole Hannah-Jones (2019) argued that “schools are not broken, they are operating as designed.” This holds true in science education where opportunity gaps leave youth of color continually at the margins (Ladson-Billings, 2006; Mensah & Jackson, 2018; Milner, 2012). Further, racial disparities in access to high quality science learning experiences in K-12 schooling leads to the persistent and pervasive underrepresentation of Black, Latinx, Indigenous and other people of color in college science majors and professions (Darling-Hammond, 2010; National Science Foundation, 2021). This matters because, while communities of color disproportionately experience environmental and health-related injustices, their voices are often missing from policy making, management, and planning efforts.

The racialization of communities of color and science learning environments shape access and opportunity in science education in numerous ways. First, science fields hold societal power and status that shape dominant narratives of what science is (e.g., objective, culture-free) and who can do science (e.g., often white, male). These narratives are problematic for youth of color who, along with their communities, are excluded from these narrowly defined categories. Second, societal perceptions of smartness, whiteness, and who does/can do science (Mensah & Jackson, 2018) shape deficit-oriented narratives about students of color (e.g., who has the ability, intelligence, and motivation to pursue science). Third, science learning environments much like mathematics classrooms, are racialized spaces where youth of color often struggle to be seen and supported as science type people (e.g., Martin, 2009; Tan et al., 2013; Visintainer, 2020; Warren & Rosebery, 2011). Finally, science is often portrayed as disconnected from youth and communities of color and incongruent with their cultural practices and lived experiences (Bang et al., 2017) making it difficult for youth of color to see how science is relevant to them and the places they live.

The same argument can be made for metropolitan areas and the intentional structuring of communities, that they too are operating as designed. As argued by David Williams (2020): “Racial inequities that matter for life and health do not reflect a broken system. Instead, they reflect a carefully crafted system functioning as planned, successfully implementing social policies, many which are rooted in racism.” U.S. sanctioned discriminatory housing policies (e.g., redlining) determined who was (and still is) allowed to live where, profoundly shaping

present-day community structures (Rothstein, 2017). As a result of racial residential segregation orchestrated by federal, state, and local governments, communities of color historically and presently experience the greatest impacts of health and environmental-related injustices (Rothstein, 2017). This means entire communities are impacted by systemic injustices, and access to, or exclusion from, educational opportunities and healthy living conditions are determined by zip code (Darling-Hammond, 2010). As described by Villarosa (2021): “From the beginning of life to the end, the environment where people make their homes, work, attend school, play, and worship has a profound influence on health outcomes (p.43).” Among the most glaring health outcomes is disparities in life trajectories for communities of color compared to those that are wealthier and whiter (Plumer & Popovich, 2020; Rothstein, 2017). For example, in Chicago, present day life expectancy differs by 30 years for residents of a Black community compared to a majority white community just *nine miles away* due to inequitable access to health care, nurturing foods, and green space (Villarosa, 2021).

However, ignorance of foundational U.S. history generates racialized assumptions about who communities of color are and why they struggle to thrive, like this gut punch of a statistic:

In 2018, the American Values Survey found that 45% of white Americans believed that socioeconomic disparities are really a matter of not trying hard enough and that if Black people put in more effort, they could be just as well off as white people (Villarosa, 2021, p.43).

Thus, in a meritocracy, narratives of individual agency and effort pervade, overshadowing the systemic injustices that make realizing these ideals an impossibility for communities of color. Whether it be about science or communities of color, author Chimamanda Ngozi Adichie (2009) explores how dominant narratives come to be: “So this is how to create a single story, show a people as one thing, as one only thing, over and over again, and that is what they become.” She expands on the power associated with controlling the narrative of people and places: “Power is the ability not just to tell the story of another person, but to make it the definitive story of that person” (Adichie, 2009). In this case, deficit-oriented societal narratives place blame on communities of color as somehow responsible for the detrimental outcomes associated with the unjust conditions in which they have been forced to live.

## 1.1 | Community-driven science: Race, place, power, and health

What does this mean for justice-centered, community-driven science? The issues highlight the need for critical approaches to science teaching and learning that support meaningful engagement with community-based phenomena at the intersection of race, place, power, and health. In this study, community-driven science is viewed from a critical stance where communities are layered, dynamic, embedded in a racialized society and hold significant power and agency (Holland et al., 1998; Lee, 2008). I build from scholars who conceptualize justice-centered science pedagogy as a disruption of systemic injustices and power structures in promotion of disciplinary learning and social transformation (Calabrese Barton et al., 2020; Davis & Schaeffer, 2019; Morales-Doyle, 2017). Further, I build on conceptions of the ways future-oriented practices, where science is intentionally integrated with histories of race, place, and power can disrupt single stories of communities, reclaim multiple place-stories, and support reimagining of communities and the people that live in them (Adichie, 2009; Gutiérrez &

Jurow, 2016; Taylor, 2018). This approach engages the sociopolitical, historical, and relational aspects of community structure and agency; balancing an interrogation of science education and systemic injustices with an asset-based perspective of community cultural wealth and resilience (Calabrese Barton & Tan, 2010; Davis & Schaeffer, 2019; Gutiérrez & Jurow, 2016; Morales-Doyle, 2017; Yosso, 2005). Scientific research, historically and presently, is commonly done on communities of color rather than in collaboration with and/or as a means to benefit those communities (Morales-Doyle, 2017). Thus, communities are positioned as objects of study and community members as problems to be fixed. However, what if communities were centered as agentic thought partners and collaborators in collective critical inquiry and action? What if science was a tool youth authored and used to reclaim their community-stories and reimagine future possibilities?

This study explores how a biology teacher from a summer science program engaged high school students of color in a three-week science unit exploring community health at the intersection of history, race, place, and power. The goal of this study is to better understand what community-driven science looks like in a science classroom when a health equity unit is guided by a biology teacher who engages the socio-historical, political, and relational aspects of community structure and agency. Using student and instructor interviews, program observations, and student artifacts, I examine how the instructor's positioning as a Black woman scientist shaped her goals and vision and the instructional and pedagogical resources made available during the unit. In addition, I explore how engaging in community-driven science practices during the unit such as critical inquiry and data analysis supported students' sense making about community health and the possibilities they imagined for their communities. The study was guided by two research questions:

- How does a biology instructor integrate science with history, race, place, and power during a community health equity unit? How does the instructor's positioning as a Black woman scientist shape her approach to community-driven science?
- How did engaging in the health equity unit shape students' sense making about community health outcomes and the possibilities they imagined for their communities moving forward? What complexities and future-oriented practices emerged?

Findings illuminate how engaging community health at the intersection of history, race, place, and power shaped engagement in community-driven science practices and supported student sense making in ways that surfaced challenges, tensions, and opportunities for disrupting and reimagining community narratives. Further, findings highlight the importance of an instructor's lived experiences and pedagogical vision in supporting emergent forms of student agency and place remaking, and generating possibilities for community healing and hope.

## 2 | REVIEW OF RELEVANT LITERATURE

This study approaches community-driven science teaching and learning from a justice-centered perspective in order to capture and disrupt the historical, political, racialized, and colonizing roots of science and science education (Calabrese Barton & Tan, 2010; Harding, 1995; Morales-Doyle, 2017). Dominant narratives about science in the United States portray scientific knowledge as objective, politically neutral, universal, and culture-free (e.g., Harding, 1995). These narratives privilege white middle class sense making practices and knowledge systems (Bang et al., 2012) and guide what counts as science in school.

The intentional segregation and structuring of communities in the U.S. by race, class, and power through federal, state, and local policies, has significantly shaped, historically and presently, access to healthy living conditions (Rothstein, 2017; Villarosa, 2021). Therefore, this study engages community structure and agency most commonly at the intersection of history, race, place, and power because these factors are highly intertwined. Examining communities and health at this intersection allows for an interrogation of systemic injustices that would otherwise be lost if various factors were explored in isolation. To support this intersectional approach, I build on literature that critically examines narratives of community and health and engages the historical, social, political, and economic intersections of future-oriented dreaming (Davis & Schaeffer, 2019; Gutiérrez & Jurow, 2016; Morales-Doyle, 2017). As described by Adichie (2009), the central power resides in who controls the narrative: “How stories are told, who tells them, when they are told, how many stories are told, are really dependent on power.” Science learning environments are viewed as sites that can become “an expansive project of engaging with multiple place-stories” (Taylor, 2018; p.195) and reimagining anew.

Further, I build on research that positions community knowledge and practices, including youths' lived experiences as disciplinary relevant tools to be leveraged in science learning environments (Bang et al., 2017). Communities are viewed as layered, dynamic, and comprised of unique strengths and assets, cultural practices, and forms of community cultural wealth that uniquely position them as collaborators and co-conspirators towards a more just future (Calabrese Barton et al., 2020; Love, 2019; Yosso, 2005). This approach positions students as knowledge producers and designers of their futures (Gutiérrez, 2008). In doing so, this study engages in community justice issues at the intersection of history, race, place, and the environment while leveraging science as a tool for liberation, imagination and community healing (Davis & Schaeffer, 2019).

### 3 | THEORETICAL FRAMEWORK

To support this study, I build on three main bodies of literature: (1) Critical and sociocultural theories of race, positioning, and learning in science education, (2) Justice-centered approaches to community-driven science, and (3) Conceptions of a racially conscious, socio-political, and community-oriented pedagogical vision in shaping instructional and pedagogical design.

#### 3.1 | Race, positioning, and learning in science education

At the foundation of the justice-centered approach to community-driven science are critical and sociocultural perspectives of race, positioning, and learning in science education. Race and racial groupings are conceptualized as socially constructed, historically embedded categories of power and privilege (Omi & Winant, 1994) with tangible outcomes for access and opportunities in science. Furthermore, as a “sociocultural construction” the meaning ascribed to racial categories is viewed as deeply rooted in social and historical conventions that significantly shape contemporary thought and discourse in science education (Mutegi, 2013). Building from Nasir (2012) and Nasir and Shah (2011), racialized narratives in science are defined as storylines with historical pasts, constructed from racist and deficit-oriented ideologies about who does/can do science, that are lived, experienced, and shape meaning making in the present. In this light, and to move away from static conceptions towards socially constructed and reproduced

phenomenon, I conceptualize stereotypes about science (e.g., who can do science) and communities of color as narratives (Nasir, 2012; Nasir & Shah, 2011). Learning is viewed as a cultural process where ways of knowing and doing are shaped by learners' cultural practices and lived experiences (Nasir et al., 2006). Positioning is viewed as the way people are assigned or denied status in powered social contexts (Harre, 2008; Holland et al., 1998). In science learning environments students of color are positioned by racialized narratives at societal, school, and classroom levels (Lee, 2008; Visintainer, 2020).

### 3.2 | Justice-centered community-driven science

Community-driven science, from a justice-centered stance, is viewed as a form of disruption, reclaiming of multi-place stories, and reimagining in pursuit of social transformation (Bouillion & Gomez, 2001; Calabrese Barton et al., 2020; Morales-Doyle, 2017; Taylor, 2018). Calabrese Barton et al. (2020) highlight recognition as a practice that legitimizes the resources students bring as having epistemological and sociopolitical value in science learning environments. Further, science practices in a community-driven science context are viewed as tools that can be authored by youth and communities for critical inquiry, analysis, and freedom dreaming (Love, 2019) in pursuit of knowledge, narratives, and possible futures generated by and for communities. From a critical perspective, science is both critiqued and leveraged; creating space for an interrogation of how scientific research has been (and still is) used to oppress vulnerable communities (e.g., Morales-Doyle, 2017), and how it can be employed for the promotion of new forms of youth agency (Bouillion & Gomez, 2001).

Communities of color are centered and viewed as historically and socio-politically situated where race and power shape their physical structuring, access and opportunity, and the racialized narratives generated and reproduced about them (Villarosa, 2021; Williams, 2020). In a community-driven science context, science practices are viewed as tools that shape student sense making and agency and can be used to reimagine and reclaim asset-based narratives of cultural community wealth (Bouillion & Gomez, 2001; Calabrese Barton et al., 2020; Yosso, 2005). Further, science practices that engage in histories of race, politics, and power (Taylor, 2018) can support youth in reimagining and constructing counter-narratives of community health.

### 3.3 | Racially conscious, socio-political, and community-oriented pedagogical vision

The lived experiences and life histories of teachers matter, shaping their orientation to students (e.g., how they see students, their potential, expectations), their goals, and what they hope students will do with what they learn (Nasir, 2004). I examine the instructor's background and goals for the unit through the construct of a "pedagogical vision." I define pedagogical vision as how a teachers' backgrounds and experiences inform their goals for teaching science, what they envision their students doing with science, and the possibilities they imagine for who their students can become in science. This construct builds from Cole's (1996) conception of ideal artifacts and the process of "prolepsis" where ideas, experiences, and cultural pasts shape imaginings of what is possible in the future. Further, it builds from Gutiérrez's (2008) call for educators to approach teaching with new pedagogical imaginations. Through the process of

prolepsis, ideal artifacts carry meaning across time and are projected into the future in ways that mediate activities at present (Cole, 1996). Bringing the idea of prolepsis into a schooling context guided by Black women educators, Nasir (2004) described how teachers' worldviews and orientations (e.g., school as family/community, students of color as inherently good) shaped the futures they imagined for their students. Further, research exploring the experiences of Black women educators illustrates a vision rooted in political clarity in that it takes a critical perspective of societal systems and injustices and is grounded in the sociopolitical context of classrooms, schools, and communities (McKinney de Royston, 2020; Watson, 2018). This study explores how a pedagogical vision that is racially and critically conscious, socio-historically and politically rooted, and oriented towards community and politicized care (Ladson-Billings, 1995; McKinney de Royston, 2020; Nasir, 2004; Watson, 2018), engages the complex tensions that surround community health equity and shapes youth sense making, agency, and opportunities to reimagine narratives of people, places, and health.

#### 4 | OVERVIEW OF METHODS

This study employs a critical ethnographic approach (Emerson et al., 2011; Foley & Valenzuela, 2005) with students and the instructor as the units of analysis. Student and instructor interviews and classroom observations are the primary data sources used in this study with student artifacts used to triangulate resources that supported student sense making during the health unit. The critical ethnographic approach employed promotes critical reflection on subjectivity and intersubjective relationships between researchers, participants, and the power structures present in society and the discipline of science itself (Foley & Valenzuela, 2005). As described by Foley and Valenzuela (2005), a critical ethnographic approach aligns with standpoint theory, a critical, feminist perspective of science that challenges the dominant positivist, universal, objective narratives of the discipline (Harding, 1995). This approach is appropriate for this study because it creates space for the various ways participants challenge notions of objectivity and universality in science through their discourse and sense making. In addition, a critical ethnographic approach centers multiplicity in learning environments and inclusivity of multiple epistemologies, lived experiences, cultural practices, and repertoires which is important for analysis of student sense making and engagement in science practices (Foley & Valenzuela, 2005). Finally, as a white woman and the researcher for this study, this approach promotes critical reflection of my own subjectivity, understanding that my stance is not politically neutral, and an interrogation of my own biases, power, and positioning (Foley & Valenzuela, 2005) while engaging with participants, during data collection, analysis, and manuscript writing. In addition, a multiple case sampling approach (Miles & Huberman, 1994) is used to explore students' sense making and agency after the unit. Through employing a critical, sociocultural perspective in my data collection, and analyses, I attempt to find out "what is" in terms of the instructor' vision and the multiple ways students make sense of community health and see themselves in relation to science, and to use these findings to determine "what could be" (Glesne, 2016) in regards to possibilities for community health justice moving forward.

This study is part of a larger project exploring learning and identity construction in science for high school students of color who participated in three different summer science programs serving youth racially underrepresented in science. This study explores students' experiences, engagement in science practices, and sense making during a three-week health



unit that took place during the biology class component of one summer program in the larger study.

## 4.1 | Learning setting and context of study

### 4.1.1 | Summer science program

The summer science program took place over the course of five-weeks at a university campus in California. The program was residential and students resided in the campus dorms for the duration of the program. The goal of the program was to bolster participants' science, technology, engineering, and mathematics (STEM) knowledge, skills, and college preparedness, and to support their STEM pathways through the duration of their high school years. In order to be eligible for the program, students had to identify with a racial group underrepresented in STEM. Students took part in a competitive application process in order to participate. First, students were required to take a math exam and obtain above a certain cutoff score in order to be included in the eligible pool of applicants. Finalists completed an interview process and the incoming cohort of students was selected from this process. The program organizers employed a competitive selection process because they felt this would lead to serving students with the most optimal chances of succeeding in STEM. Students entered the program as rising 10th graders and agreed to participate in the summer program for their three remaining high school years. Participants were divided into three cohorts by grade level (10, 11, 12).

### 4.1.2 | Biology class and health unit

The biology class was one of several components (e.g., research experience, math class) that students in the 10th grade cohort participated in during the summer program. From Monday to Friday, participants attended classes much like a regular school day. Students attended biology class three times per week for 2 h per class over the five-week program. The health equity unit that took place in the biology class, and is the focus of this study, was 3 weeks in duration. See Table 1 for an overview of the health equity unit including key ideas, teaching resources, and science practices students engaged in during the unit.

## 4.2 | Participants

### 4.2.1 | Students

Participants for this study were the same students that participated in the larger research project on learning and identity construction in science. Interviewees for the larger research project were selected based on responses to a pre-program survey that included questions about science identity and perceptions of science ability. On the survey, students were asked if they would be willing to participate in interviews. Six students who agreed to participate in interviews were selected that captured a range of ways students saw themselves as science learners when they entered the program with attention to selecting an equal number of boys and girls. The range is not relevant to or explored in this study, but the same six focal students included in the larger project were included in this study.

**TABLE 1** Health equity unit: Key ideas, teaching resources, and science practices.

Class	Key ideas	Teaching resources	Science practices
1	<ul style="list-style-type: none"> <li>• Overview: Health inequities</li> <li>• Race, racism, socioeconomic status (SES), place, health outcomes</li> </ul>	<ul style="list-style-type: none"> <li>• Readings</li> <li>• Graphs of race, SES, income, health outcomes</li> <li>• Class discussions</li> </ul>	<ul style="list-style-type: none"> <li>• Asking questions</li> <li>• Critical inquiry/data analysis</li> </ul>
2	<ul style="list-style-type: none"> <li>• How is disease defined? Conceptions of disease</li> <li>• Body systems and disease</li> <li>• Stereotypes: Culture, food choices</li> </ul>	<ul style="list-style-type: none"> <li>• Handouts</li> <li>• Graphs of health indicators by race, SES</li> <li>• Students' community experiences</li> <li>• Class discussions</li> </ul>	<ul style="list-style-type: none"> <li>• Asking questions</li> <li>• Critical inquiry</li> </ul>
3	<ul style="list-style-type: none"> <li>• Key health indicators by race, SES, place</li> <li>• Access to healthy food, environment</li> <li>• Students' food cultures and practices</li> </ul>	<ul style="list-style-type: none"> <li>• Table of health indicators/statistics</li> <li>• Students' cultural food practices</li> <li>• Students' community experiences</li> <li>• Class discussions</li> </ul>	<ul style="list-style-type: none"> <li>• Critical inquiry/data analysis</li> </ul>
4	<ul style="list-style-type: none"> <li>• What is obesity?</li> <li>• Causes, effects</li> <li>• Stress</li> </ul>	<ul style="list-style-type: none"> <li>• Graphs of health indicators: Race, SES, place</li> <li>• Students' community experiences</li> <li>• Class discussions</li> </ul>	<ul style="list-style-type: none"> <li>• Asking questions</li> <li>• Critical inquiry</li> </ul>
5	<ul style="list-style-type: none"> <li>• What impacts your health the most: Personal choice, income, race, place?</li> <li>• Sugar: Health impact</li> </ul>	<ul style="list-style-type: none"> <li>• Group debates</li> <li>• Students' community experiences</li> <li>• Class discussions</li> </ul>	<ul style="list-style-type: none"> <li>• Asking questions</li> <li>• Critical inquiry</li> </ul>
6	<ul style="list-style-type: none"> <li>• Community Health Investigations: Focus/questions</li> <li>• Survey design</li> <li>• Preparation for data collection</li> </ul>	<ul style="list-style-type: none"> <li>• Investigation design</li> <li>• Survey design</li> <li>• Examples of surveys</li> </ul>	<ul style="list-style-type: none"> <li>• Student investigations</li> <li>• Data collection preparation</li> </ul>
7	<ul style="list-style-type: none"> <li>• Field trip: Conduct survey</li> </ul>	<ul style="list-style-type: none"> <li>• Community health</li> </ul>	<ul style="list-style-type: none"> <li>• Data collection (Investigations)</li> </ul>
8	<ul style="list-style-type: none"> <li>• Limitations of data</li> <li>• Sources of error</li> </ul>	<ul style="list-style-type: none"> <li>• Student survey data</li> <li>• Class discussion</li> </ul>	<ul style="list-style-type: none"> <li>• Data analysis (Investigations)</li> </ul>
9	<ul style="list-style-type: none"> <li>• Prepare presentations</li> </ul>	<ul style="list-style-type: none"> <li>• Components of presentations</li> <li>• Slide design</li> </ul>	<ul style="list-style-type: none"> <li>• Data analysis</li> <li>• Presentation (Investigations)</li> </ul>
10	<ul style="list-style-type: none"> <li>• Presentations</li> <li>• Posters, verbal presentation</li> </ul>	<ul style="list-style-type: none"> <li>• N/A</li> </ul>	<ul style="list-style-type: none"> <li>• Presentations (Investigations)</li> </ul>

Students in the 10th grade cohort took the biology class. There were 22 students in the biology class. Six of the 22 students participated in interviews as outlined above. The six focal students attended various racially diverse, urban, public high schools in a large California metropolitan area. The three young women and three young men included in this study are as follows:

Elana<sup>1</sup> was proudly Mexican and described herself as shy. She was the oldest child of five and would be the first in her family to attend college. She was interested in math and science and felt like she was good at both subjects. She was determined to go to college, and though undecided about her career goals, thought architecture or engineering sounded interesting. She joined the program to gain college preparation experience and to bolster her STEM skills.

Gabriella was Chicana and described herself as nerdy and awesome. She was interested in math and science and felt confident in her abilities in both subjects. She enjoyed science the most but did not see herself pursuing a STEM major in college. Instead, she was interested in exploring some aspect of the arts in college. She joined the program to gain experience with college life and to build on her math and science skills and interests.

Naomi was Black and described herself as smart, curious, and whimsical. She strongly identified with science and said she “saw the world through science eyes.” College was a priority and she wanted to go into the medical field like members of her family. She joined the summer program because she thought it was a “great opportunity” that she did not want to pass up and felt it would be good preparation for college.

Lorenzo was Mexican, undocumented, and described himself as shy. He was multilingual, having grown up in Mexico, and moved to the United States in elementary school. English was his third language and while he was fluent, he felt insecure about his English language abilities. He was very interested in and felt good at math but lacked confidence in science. College was a priority and he wanted to pursue a career where he could help people and his community. He joined the program to strengthen his math skills and prepare for the upcoming school year.

Ronald was Caribbean/Black and moved to the United States from Jamaica when he was in elementary school. He described himself as confident, but not over confident, and intellectual. He enjoyed math and science and felt very confident in his skills. He was interested in pursuing math, engineering, and/or business in college. He joined the summer program to bolster his math skills and because he thought it would be good preparation for college.

Lucas was Latino and described himself as athletic, smart, and determined. Science and math were his favorite subjects in school and he was confident in his abilities. Attending college was a priority and was interested in pursuing biochemistry or bioengineering because he wanted to “make life better.” He joined the program to gain knowledge and to become more comfortable interacting with others.

#### 4.2.2 | Instructor

The biology instructor for the program, Felicia, was a high school science teacher and had double majored in Biology and Africana Studies during her undergraduate degree program. She was in the process of transitioning from high school science teaching to medical school after the summer program. She identified as Black. She designed and taught the five-week biology course for the summer program including the three-week community health equity unit. The students referred to her as Miss Felicia. She is referred to as Felicia throughout this manuscript.

### 4.3 | Data sources

This study draws from three data sources: (1) Interviews (students, instructor), (2) Classroom observations, and (3) Student artifacts. Interviews and observations were the main data sources used in this study.

### 4.3.1 | Interviews

Instructor and student interviews were semi-structured, conducted one-on-one with the author, and audio-recorded. The interview protocols were designed from an interpretivist perspective using different types of questions (e.g., descriptive, structural) (Spradley, 1979). One instructor and six students participated in interviews.

#### *Instructor interview*

The instructor interview took place just after the health unit had ended. The student interviews took place at the end of the unit/summer program. The instructor interview protocol was designed to capture the instructor's background and experiences with science, pathway into science teaching, and goals for the health unit. Questions included: (1) Tell me about your pathway into science, (2) Describe your high school teaching experience, (3) What are your biggest goals for your teaching during the summer program?

#### *Student interview*

The student interview protocol was designed to capture students' experiences during the program and the health unit, how they saw themselves in relation to science, and their sense making practices. A subset of questions from the larger interview protocol focused on student experiences and sense making specific to the health equity unit; the focus of this study. These questions included: (1) What were your main take away's from the health unit? (2) What was your take on the guiding question for the health unit: Does personal choice, race, income, or environment/place impact health the most?

### 4.3.2 | Program observations

Program observations were conducted by the author three times per week for 2 h during the health unit for a total of 18 h. Field notes were recorded on paper using ethnographic approaches (Emerson et al., 2011). The observation protocol was designed to capture the classroom setting, interpersonal interactions, instructional and pedagogical approaches, and student engagement in science practices. Particular attention was paid to the six students that were interviewed during classroom observations. However, class activities, student/student and student/instructor interactions, and moments of positioning were also recorded for the class as a whole.

### 4.3.3 | Student artifacts

The culminating project for the unit was a student-led investigation exploring a community health issue of their choosing. Students presented their final products in two formats: (1) Posters showing their research questions, data collection methods, analysis, and findings, (2) Presentations during the final class. Photographs of the posters were taken for future analysis.

## 4.4 | Data analysis

### 4.4.1 | Interviews

Interviews were transcribed and read in full. Coding was done inductively through an open coding process and categories were constructed through an iterative process (Miles & Huberman, 1994). Aligned with the justice-centered orientation to community-driven science and conception of a pedagogical vision presented, the coding and analysis process centered critical and sociocultural perspectives of race, power, science, and societal systems. Interviews were analyzed through the following process: First, transcripts were coded using descriptive codes. Transcripts were read in their entirety by the author and statements associated with the themes were noted. A participant's sense making and the meaning they associated with these ideas were inferred through analysis of complete utterances and turns before and after a statement to provide sufficient context. Second, coding categories were developed with particular attention to the critical perspectives of race, power, and science that were shared by participants. Coding categories were refined through an iterative process of applying codes to transcript sections.

#### *Instructor interview*

Analysis of the instructor interview centered the conception of political clarity (McKinney de Royston, 2020; Watson, 2018) demonstrated through a critical analysis of science, community health, and societal inequities. The instructor interview was coded for the following themes through a critical lens: (1) Background and pathway in science, (2) Perspective of science, (3) Approach to science teaching, (4) Goals for the health unit. Coding categories for the instructor interview emerged from the instructor's own science experience in K-12 schooling, her undergraduate training and engagement with science at the intersection of history, race, place, and power, and experiences teaching high school science to minoritized youth in an underserved urban school. For example, for "perspective of science," statements that described experiences that shaped the instructor's view of science such as: "Looking at science from a feminist perspective," "notions of objectivity in science," and "the fact that science comes from a very specific culture" were counted in this category.

#### *Student interviews*

Student interviews were coded through a critical lens for the following themes: (1) Experiences with and ideas about community structure and agency, and (2) Sense making about health outcomes. Coding categories for community structure and agency emerged from students' experiences in their communities around themes such as: forms of racial bias and discrimination they experienced, access or lack of access to nutritional foods, density of fast food restaurants, and their own food traditions. Coding categories for student sense making about health outcomes emerged from factors included in the guiding question for the unit: personal choice, race, income, environment, other. Students' sense making was categorized based on what factor(s) they described as impacting health the most. Sections of interview transcript directly before and after the question were read to gather a more expansive view of students' sense making. For example, a student described his sense making: "I believe that it is your personal choice about how you maintain your health." This squarely fits into the "personal choice" category. In other cases, students cited multiple ideas. For example: "you can always try to find support somewhere else" was coded as personal choice because it was on the individual to find the resources needed. This same student reflected further: "You might try to eat healthy but, let's say you're

homeless, you don't have any money." This aspect of his response was categorized as "income." In cases like this, student responses were counted once per category but could be included in multiple categories.

#### 4.4.2 | Classroom observations

Observational notes were read in full. Field notes were coded for social interactions (student, instructor), moments of positioning, and instructional and pedagogical resources made available during the unit (Emerson et al., 2011). Particular attention was paid to how the resources Felicia made available were taken up, contested, or resisted by students. In some cases, resources were flagged in real time, during the recording of observational notes. For example, when particular interpersonal relations felt significant it was labeled with "relational resource." In other cases, the instructional/pedagogical resources were coded through the analysis process. Significant moments during the health unit were noted.

#### 4.4.3 | Artifacts

Projects were analyzed to explore students' research questions and findings. Artifact analysis was triangulated with student interviews and observations to better understand how students' investigations shaped their perspectives about community health.

#### 4.4.4 | Triangulation of data sources and analyses

The process of triangulating data sources and analyses allowed for robust claim testing and building. For research question #1 (i.e., How does a biology instructor integrate science with history, race, place, and power during a community health equity unit?), instructor interview analyses were triangulated with observational fieldnote analyses. For example, analysis of the health unit goals that Felicia described during her interview were explored in conjunction with analysis of fieldnotes for moments of positioning and when instructional/pedagogical resources were made available that aligned with these articulated goals. Similarly, to explore Felicia's positioning as a Black woman scientist, it was critical to examine analysis of her interview together with classroom observations that illustrated how her approach to community-driven science came to life. For research question #2 (i.e., How did engaging in the health unit shape students' sense making about community health outcomes and the possibilities they imagined for their communities moving forward?), student interview analyses were triangulated with classroom observational field notes and artifacts from student investigations to explore how engaging in the unit and projects shaped their sense making about community health outcomes.

## 5 | FINDINGS

To address my research questions, first, I explore the biology teacher's orientation to community-driven science and approach to engaging students in critical science inquiry and

analysis at the intersection of race, place, and power. Second, I examine how the teacher's positioning shaped the instructional and pedagogical resources made available during the unit. Third, I explore how students engaged with science practices, their sense making about community health outcomes following the unit, how they navigated tensions and limitations of existing narratives, and reimagined new possibilities.

## 5.1 | Community-driven science: History, race, place, power, and health

Felicia's orientation to community-driven science was shaped by her background, K-12 schooling experience, and training in college in important ways. In addition, her goal to pursue a medical career that centered community health shaped her approach to science teaching and learning and the design of the health equity unit.

### 5.1.1 | Background and K-12 schooling experience

Felicia grew up in a family of modest income, but recalled living in affluent, predominantly white communities because they provided access to well-resourced public schools. She reflected fondly on her experiences with science in school: "My exposure to science has always been really positive in my schooling. I've always had really awesome science teachers." This shaped her goal to pursue science early on: "For a long time I always knew I wanted to do science." At the time of the interview, Felicia was transitioning from high school science teaching to medical school. She described a summer program she participated in after sixth grade with a Indigenous perspective of health care: "I left that program being like, I really want to be a doctor."

Because of the communities in which she grew up, she was immersed in aspects of predominantly white culture early on and often felt alone as a Black student. She described her experience as "pretty much a lifetime of being like one or two Black kids in class." She was in the International Baccalaureate (IB) program in high school where racial disparities in access to high-level science courses became even more stark: "Once you got into higher level classes it would be really hard to see that diversity, when you start tracking kids. I was in the IB program in high school, and there were four Black girls, no Black boys, out of 60 kids in the program." Thus, while she felt supported in school and science, she did not see herself represented in science, and felt alone as a Black student.

### 5.1.2 | Engaging narratives of history, race, power, and health

This limitation shifted in college where she double majored in Human Biology and Africana Studies. It was during college that Felicia learned science was "way more complex than I ever thought." She took courses that broadened her perspective: "We explored science in society and the idea that science comes from a very specific culture." By looking at science from a "feminist and Africana perspective," she began to question Western constructions of science and developed a critical perspective, questioning "notions of objectivity in science." In her coursework, societal narratives were problematized: "Poking holes in dominant narratives of everything, including science." She gained awareness of colonizing scientific practices of treating

communities and people of color as study objects and how this history directly connected to modern science fields including medicine (her future career): “Taking women from South Africa and bringing them over to look at their hearts, like objects, and then there’s medicine which comes out of that tradition!” It was during her undergraduate years that she began to explore societal constructions of health, who determines what it means to be healthy, and structural aspects of health equity and justice. She explored intersections of history, race, class, and health: “One of my classes, health and historical perspectives, looked at how class and race informs notions of health and disease and what those categories actually are and who is healthy and who is diseased in general.” In addition, she built on her understanding of the deep ties between power, health, medicine, racism, and constructions of human hierarchies:

Thinking about Africa and how that was the beginning of people looking at the physiology of the body and comparing people and categorizing bodies. Essentially the roots of health and the roots of modern medicine are entirely in the roots of racism and categorizing and diseasifying people if that’s a word (laughs).

The central themes of historicity, power, critical inquiry, and questioning social constructions of health were themes that Felicia carried with her to the health unit in the summer program.

### 5.1.3 | High school science teaching: Awareness of racialized expectations

Prior to teaching in the summer program, Felicia had spent 2 years teaching high school biology and chemistry at a majority Black and Latinx urban public high school. Due to structural inequities in educational access and opportunity, Felicia felt like she was “teaching against a lot of obstacles” and students came to her with “strange gaps.” However, the biggest obstacle was students’ low self-confidence due to years of low expectations placed on them (e.g., by teachers, schools, society) and lack of access to high quality science instruction:

The hugest obstacle was just my students not having faith in themselves, like not having any real faith that they were smart enough to do what we were gonna do in class, that they could use science, that they could be attached to it and excited about it in any way.

Conceptions of intelligence (“smart enough”) and who can do science were racialized narratives she hoped to address through her teaching. To support students, she tapped into what she viewed as a foundational aspect of human nature: “With most people there’s a natural, really awesome curiosity about the world and how it works. Science is a great way to satiate that desire.” Felicia felt that science as a form of inquiry was “always present for people” as part of the “human experience” across culture, time, and context. It was from this foundation that she sought to promote engagement in science practices that could be applied in and outside of science and school. She focused on a central scientific practice of asking questions:

Ultimately, it’s the only thing that guides me about science. If people want to ask questions, than that’s all you really need to have. Ask questions and have the desire



enough to figure out how to get that question answered or figure out how to ask more questions while trying to get that question answered.

Felicia described science knowledge as generative and student-guided. She followed the science standards at the time yet described her instructional approach: “Ultimately that’s what I started focusing on more in my classroom, getting students to question and be engaged rather than making sure that they knew the nucleus was super dense.” Thus, Felicia promoted engagement in science practices as vital to knowledge construction in the science classroom.

Felicia’s perspective of students as natural scientists and capable learners who needed support to realize their power and potential guided her teaching in the summer program. She also hoped to empower students to use science practices in a way that would build their confidence as learners and doers of science. She tapped into notions of smartness in science and who belongs based on her own pathway in science specifically as a woman of color. She described the importance of self-confidence when navigating the racialized world of science:

Being able call on your inner scientist, so when you get challenged, when someone just assumes that you cannot do something or assumes that you are in that class because your university needs to make a quota or assuming that you do not really deserve to be there, you can have your own spirit and force of confidence: ‘No I’m supposed to be here, no I know I’m just as smart as you are, and I can do whatever I need to do.’

Based on her own experiences in K-12 schooling, college, and as a high school science teacher, Felicia understood what it meant to navigate racialized narratives about merit, affirmative action (“making a quota”), and who belongs in science. She sought to nurture students’ “spirit” and confidence to support them along their pathway.

#### 5.1.4 | Goals for the community-driven science health unit

As a Black woman and scientist, Felicia brought a unique perspective to community-driven science in general and the health equity unit in particular. During the summer program she designed and taught a biology unit on the topic of health equity at the intersection of history, race, place, and power. The unit Felicia designed operated at this intersection because who lives where in the United States (i.e., community structuring based on race and class) is based on historical and racist US government policies and practices with significant present-day impacts on health and well-being. Thus, while aspects of the unit foregrounded different dimensions, due to the highly intertwined nature of history, race, place, and power, the unit operated at this intersection overall. Felicia had several goals for the health unit based on her background, experiences, positioning, and expertise as a scientist. First, based on her own experiences as a student and the racialized assumptions she navigated about her ability, Felicia aimed to create a close, caring, inclusive community of learners. Second, building from her undergraduate training, she wanted students to explore racialized societal narratives about health and how “class and race inform societal notions of health and disease” with a particular focus on community health. Third, she built on her experience engaging high school students in science practices and sought to support students in using and authoring science as a tool to question and critique information including how statistics and data are presented and the types of narratives about

their communities generated by outsiders (e.g., society, the media). She described her approach to promoting critical inquiry about societal views of community health:

I want everyone to go back to their community knowing that, being more skeptical and critical of how health is, how they are introduced to health in their communities. So for instance not assuming that it's a community's fault that they are in poor health, or, not assuming that things that they see in the news about genetics and essentially re-biologizing race are true.

The themes of and tensions between community structuring and agency (e.g., assumptions that poor health is the fault of the community) were prominent throughlines in her teaching. Felicia highlighted how media reproduced racialized and deficit-oriented narratives about community health. By engaging students in science practices, she sought to support students as critical thinkers and problem solvers, who had agency in their own well-being: “A lot of the focus on health for me is, and it's usually health and race, is getting my students to think more critically about what are the actual connections between health and race and how they can be healthy themselves.” She wanted students to author and use community-driven science practices to examine issues directly connected to themselves and their communities and construct narratives about the “realities about yourself and your community and humanity.” In this way, students could share their own stories, constructed from within and create counter-narratives to disrupt and reimagine those projected onto their communities.

## 5.2 | Community-driven science in the biology classroom

Felicia's background, experiences, and positioning shaped her approach to community-driven science in the classroom and the instructional and pedagogical resources she made available during the health equity unit. She promoted health justice by engaging students in curricular resources and critical inquiry around health outcomes and disparities for communities of color. In addition, she fostered engagement in the theme of relationality in community structuring and agency. Together, she did this across three main contexts: First, she created a supportive learning community where students felt comfortable sharing their lived experiences, systemic injustices, and community narratives of health. Second, Felicia leveraged students' cultural practices as instructional resources. Third, she engaged students in community-driven science practices that included an opportunity for students to explore issues of community health important to them during their final projects. The unit was guided by an overarching question: “What impacts your health the most: Personal choice, income, race, or the environment/place?” This question was continually revisited during the unit.

### 5.2.1 | Supportive classroom community of learners

During the health unit, students engaged in collaborative inquiry and critical analysis at the intersection of history, race, place, and power. To set the foundation for this important and emotionally intensive work, Felicia created a safe, responsive, and inclusive learning environment where students developed trust in each other through a caring community. She did this by making relational resources available in several ways that reflected her own experiences in

K-12 schooling and as a high school science teacher serving predominantly Black and Latinx students. When students discussed personal topics and experiences, she created a safe environment that centered humanity and dignity. This included making herself vulnerable as a member of the learning community by sharing her experiences of racism, discrimination, and health. For example, in the beginning of the unit, she projected a table of key health indicators by race, gender, income, and health insurance status. Felicia asked the class: “What do you notice or find interesting?” From her positioning she added: “I feel a little under threat, African Americans are showing up way too much on this (table).” This move brought the statistics into reality, students immediately had their teacher as an image of whose lives were reflected in the numbers. Students began discussing disparities in health indicators by gender and race. They were sitting in their seats at lab benches with high shelves which made it almost impossible for students to see each other. One student highlighted disparities between incidences versus mortality rates for breast cancer. Felicia responded: “Right, the table shows that white women get breast cancer more often, but African American women are more likely to die from it.” A heavy topic, made more real with Felicia placing herself within the statistics. Long pauses and mostly silence followed. Based on the reality of her positioning and lived experience reflected in the statistics, she sensed the group tension immediately, adapted quickly, and stopped the class: “Close your computers, gather in the middle with your chairs, this is about being close, we’re family here.” Students began to get up and move their chairs together. Felicia guided them into a tight circle: “Get closer, I want you to see each other’s eyes.” By having students pull their chairs into a close circle, Felicia instantly changed the learning community structure; both the physical space and orientation of the group. This move was significant because it positively shifted the sense of connection, safety, and care among the community members immediately. It also communicated that emotion and science learning are not mutually exclusive. As a result, and following Felicia’s lead at expressing vulnerability, a personal and engaged discussion ensued where students felt safe sharing their personal experiences, ideas, and questions. Thus, Felicia attended to inclusion and safety; a move built from her experience of being the “only one” as a Black student in high-level science courses and navigating racialized assumptions and biases about her ability and belonging. Felicia’s positioning shaped the vulnerability she expressed at locating herself in the statistics, her immediate attunement to the tension that surfaced among students, and her reflexive practice that allowed her to adapt quickly and effectively to create safety. These key moves allowed the group to move into deeper levels of analysis than would have otherwise been possible.

### 5.2.2 | Leveraging community assets and cultural practices as instructional resources

Once the group had established a foundation of community care and safety, they began the work of critical inquiry. Through pedagogical moves such as positioning students as valuable members of the learning community, Felicia cultivated trust and showed that their contributions were valued and relevant to their shared learning. Furthermore, she supported students’ science and racial identities by valuing and leveraging their community and cultural assets. For example, when exploring data on obesity and diabetes rates at the intersection of race, gender, and place, Felicia elicited students’ knowledge and experiences. She stated findings from a report: “First generation immigrants are healthier than most Americans.” Students, especially those in the class from Latinx and Caribbean families that had immigrated to the United States

were visibly excited; some students even gave each other high fives. She then had students ponder why this might be given the myriad injustices immigrant communities often experience. This instructional move created an opening for students to reflect on their family traditions and the strengths of their food cultures. For example, Lucas, whose family had immigrated from El Salvador, observed on a recent visit back to see his grandmother that there were a lot more fresh, local food options compared to his community here. He described how his grandmother used a freshly killed chicken for the dinner she prepared along with other home-grown ingredients. Another Mexican-American student described how in Mexico the tacos were made with simple, fresh ingredients and, as a result, were much healthier and tasted better. Students' cultural foods and practices were positioned as sources of pride and strengths to build on. Another student described the importance of food cultures and traditions: "People that are immigrants need to keep their cultural foods, their own values and traditions, not let fast food get to you, there should be more support." This framing suggested food cultures need to be protected as a form of resistance and community resilience. Further, the student suggested that "more support," perhaps in terms of food access, would help immigrant communities to thrive. Felicia built from her positioning as a member of a demographic group that is the target of racialized assumptions. Further, she leveraged her science expertise to critically engage intersections of race, class, and conceptions of disease and make resources available that challenged racist and classist notions of health. By leveraging the strengths of youths' food cultures, Felicia made resources available that directly disrupted dominant societal narratives of who is and can be healthy.

### 5.2.3 | Engaging in community-driven science practices

Building from her experience as a high school science teacher, Felicia supported students in authoring and using science as a tool to explore health justice at the intersection of race, place, and socioeconomic status. Her overall goal was to help students develop the science practices needed to think critically about health/societal inequities and to "separate differences between stereotypes and what's true" in order to disrupt racialized narratives placed on them and their communities. This goal aligned with her undergraduate training and the expertise she gained engaging critically in these topics. To do this, she engaged students in three main science practices: (1) Asking questions, (2) Critical inquiry through data analysis, and (3) Student-led investigations. These science practices were tools that students authored and used specific to a community-driven science context. At the heart of Felicia's approach was positioning students as researchers whose lived experiences as community members shaped their "doing" of the practices. Further, she engaged students in the messy intersections of science, race, place, and power.

#### *Asking questions*

Through readings and class discussions, Felicia supported students in asking questions, a practice she leveraged as a high school science teacher and viewed as foundational to making science learning accessible. She wanted students to question and critique their world as it related to community health. She scaffolded this through promoting strategies to "evaluate sources and information":

I want students to feel competent that they can engage with science, feel competent in their science knowledge, but more so, have the skills to, first, have a question and then be able to answer their question on their own.

She also elicited students' personal stories and lived experiences and together the group reflected on readings in relation to observations students made from their own communities. For example, Felicia engaged in discussions of social constructions of health and disease ubiquitous in society, school, and youths' lives. This included considering how narratives about health are generated and evolve over time. For example, at the beginning of the unit, the group discussed conceptions of disease. Felicia asked: "When you hear the word disease what comes to mind? How is disease defined?" Students brainstormed ideas: related to bacteria, external and internal, something bad. Afterward, Felicia asked: "Why is disease sometimes difficult to conceptualize?" She then provided a historical example to illustrate her point: "In the 1960's homosexuality was considered a disease. How has this changed over time? What does this tell you about how disease is conceptualized?" Students discussed how conceptions of disease evolve and how intersections of science, culture, power, and society shape sense making, narratives, and biases. Readings that highlighted intersections of health outcomes, structural inequities at community levels, and the deficit ways communities are portrayed generated more questions among the group. For example, students read short pieces from educational materials created for the PBS film "Unnatural Causes." Felicia viewed asking questions as a way for students "to be connected to science in some way" because the practice stemmed from having a "very natural, really awesome curiosity about the world." The class generated questions from readings and their observations in their own communities and addressed the questions throughout the unit.

### *Critical inquiry and data analysis*

Drawing on her undergraduate training and science expertise, Felicia supported students in developing critical inquiry and data analysis skills by fostering constructive, evidence-based debates about complex topics. Students explored and analyzed graphs and other data representations of various health statistics by demographic group (e.g., race, gender, socioeconomic status). Importantly, she reminded students to consider their own experiences, biases, and assumptions, and things that they had heard, and in some cases internalized, about health and their communities as they analyzed data. Engaging in critical inquiry through data analysis in this way cultivated a critical community that explored dominant societal narratives about community health in relation to scientific evidence. Through this process, the subjectivity of data analysis and the importance of who is doing the analyses emerged. Students interpreted graphs showing the impacts of income inequality (by country) on numerous factors including mental health, life expectancy, and obesity and diabetes rates. Interpretation of the graphs fostered robust sense making. Felicia engaged the complex intersections, biases, and assumptions that emerged as central to developing critical thinking and analysis skills. For example, during one class Felicia projected a graph of diabetes rates by race, gender, age, and insurance status:

Felicia: Who should be more likely to get diabetes? Think about race, ethnicity, gender. Based on the biology of the disease only, who should get it?

Students: African Americans get diabetes most, then Latinx people, then white people, men more than women.

Felicia: Notice I distinguished between who does and who should. You did a good job telling me who does get diabetes, not who should. Is there a gender or race that's more prone to Type 1 diabetes? Do you understand what I'm saying? Anyone, can get diabetes, when it comes to should, no one should get it more. We all have a pancreas. Who's body uses insulin to digest sugars?

Students: (Everyone raised their hand).

Felicia: What we see is more men and more minorities. I want to have a discussion about why there are inequities in who gets diabetes.

This move was important because it integrated concepts from the previous unit (e.g., form and function of body systems) with interpretations of data and the role of societal assumptions in shaping meaning making. Felicia's expertise and her experience critically exploring intersections of race, class, and notions of health in her undergraduate training were central to shaping her practice in this moment. Distinguishing "who should" from "who does" in the context of body systems clarified the disparities that certain groups experience in relatable ways. The class went on to discuss factors that impact diabetes rates including structural inequities and racialized and gendered assumptions and the disproportionate impact on minoritized communities.

In another example, the class had conversations about health and power through complex discussions of food access. For example, while making sense of health data, Felicia asked why there was a higher density of fast food restaurants in communities of color, why healthy food cost more in their communities, and how this connected to larger power structures. During the discussion, racialized biases emerged about different groups of people and food choices (e.g., racialized conceptions about who makes unhealthy food choices). Instead of avoiding tensions between power structures and these narratives, Felicia engaged students in sense making:

Student 1: People of color live in food deserts, cannot get nutrients they need, all around is fast food.

Student 2: It comes down to morals, how you are raised, I live around fast food and do not eat it.

Felicia (to class): What are your reactions?

Student 2: Also comes down to income, you will eat what you need to in order to survive.

Student 3: Businesses see opportunities to target and make money off of communities of color through alcohol, tobacco, and other things.

Student 2: Younger kids are easier to influence, target with fast food like McDonalds.

Student 4: It's about making money off of us, white owned businesses making money off of communities of color.

When viewed through a critical lens, students gained an understanding of dominant power structures at play shaping access and opportunity, community structure and agency, and limiting which communities have an opportunity to thrive in a capitalistic society. Felicia encouraged students to "notice in our discussion assumptions about people, gender, or race." By grounding the analysis in her and the students' community experiences ("us"), Felicia made resources available that created opportunities for students' lived experiences to become a critical lens for data analysis and interpretation.

Finally, Felicia promoted expansive perspectives through a holistic perspective of health. She promoted the idea that while food was important, health was about much more than food and the group considered environmental factors, and impacts of racism on stress, anxiety, and mental health. For example, Felicia set aside a class session to discuss stress and anxiety as it relates to racism and discrimination:

Wednesday is about stress because I think stress is a major killer. If everyone can learn at an early age how to manage their stress we'd live much better lives and so, part of the lessons are just selfish, like here be healthy!

Felicia sought to support students in gaining tools and skills to navigate the stress in their lives while also scaffolding critical thinking skills. Her word choice of “selfish” is notable. She expanded on what she meant: “I guess it's not selfish but my own goals rather than me supporting their STEM goals.” Her statement suggests she experienced personal health as it relates to racism as outside of the STEM standards and/or program expectations.

### *Community health investigations*

The culminating project for the unit was entitled: “Investigating a Local Health Concern Using Data”. The project was designed to build from the critical inquiry, data analysis, and other community-driven science practices that students had engaged in during the unit. Students worked in teams of two to collect and analyze data related to food access and health-related conditions in various neighborhoods. Students had an opportunity to ask a research question of their choice and then collected empirical data to answer their questions. Through the investigations, they engaged in the practices of asking and answering a research question, designing and conducting investigations, planning and carrying out data collection and analysis, making claims based on their findings, and presenting their findings to the class. They were asked to approach their findings in relation to their knowledge of biology. The goal of the projects was to explore what they learned during the unit in context and to gain understanding of how to conduct a study.

Students explored a variety of topics for their projects including those related access to healthy food. For example, one group examined distances to reach grocery stores versus fast food restaurants. Another group explored presence of Type 2 diabetes in food deserts. Other groups explored rates of obesity and space/conditions for exercise or in communities with a high density of fast food restaurants. Because of limitations on time and other constraints, students most commonly designed surveys that they conducted in person or distributed via email or social media and then analyzed patterns in the data. The class engaged with how to design instruments for data collection, statistical analysis methods such as determining correlations versus causation, and the limitations of their studies.

The health equity unit presented constant negotiation and navigation of community structuring and agency through societal beliefs and biases, racialized narratives, and health data. Felicia continually repositioned community members as agentic and the presence of inequities as a result of community structuring, not shortcomings of individuals. Felicia discussed the challenges of working against dominant forms of relationality (e.g., individual agency) and racialized societal conceptions of health:

I'm worried about what they actually take up, but I'm seeing as their doing their projects, they are free writing on their own about their topics which are chosen

around the idea of health inequality. I'm like 'alright he got that!' So they are picking up some things, connecting, the choices you make around your diet, to where you live, and how that may not be an easy choice. And just evaluating health in America and how American's health is greatly affected by inequality.

### 5.3 | Student sense making and reimagining community narratives

Throughout the unit, students engaged in science practices and experiences at the intersection of race, place, socioeconomic status, and power. In addition, Felicia centered discussion of community structure versus agency that challenged and repositioned dominant and racialized societal narratives of relationality and health in communities of color. During post unit interviews, I asked students about their experiences during the unit and to reflect on the guiding question during the unit: What factors impact community health the most? Is it personal choice, income, race, or environment/place? Student sense making about community health outcomes was sophisticated and complex. In their responses, students made sense of health inequities in the context of broad societal and institutional structures and their own experiences and identities. While all students expressed an understanding of structural limitations, they balanced this with maintaining individual agency to different degrees and in different ways. Students' responses were categorized into four main themes based on the guiding question: personal choice, income, race, and/or environment. The most common factor students described as impacting health outcomes was personal choice followed by income and race.

#### 5.3.1 | Personal choice and individual agency

Some student drew heavily on pervasive narratives of personal choice; a dominant form of relationality ubiquitous in a capitalistic and racialized society that promotes meritocracy and individual agency as pathways to success. In all cases, students in this category expressed awareness of societal and structural limitations on communities of color, yet felt that individual motivation could overcome systemic barriers. For example, Lucas described his experience as a Latino student: "I'm a minority, and people look down on minorities." He expanded on how this racialized societal narratives (i.e., being looked down on) intersected with health: "Because the fact of being a minority, you have all these disadvantages, like in my project, more chances of having diabetes." Lucas had conducted his project on diabetes rates in the Latinx community. He expressed what he learned from his project about the impacts of inequitable structures on health (higher rates of diabetes in his community). Thus, he integrated broad structural inequities with his personal experiences and described the role of the project in shaping his sense making. However, in the end, he described personal choice as the most important determinant of health outcomes:

I believe that it is your personal choice about how you maintain your health. Because you could be in a really bad environment, but you could also find other ways to escape your environment, not necessarily escape, but find other options. And even if you were to eat fast food because that's all you live around, you could always do more exercise and try to find the healthiest things you can find at those places.



Lucas described a complex tension between structural inequities that limit possibilities for minoritized communities (e.g., living in a “really bad environment”) and the idea that ultimately, individuals make a “choice” about maintaining their health. In doing so, he placed the responsibility on individuals to navigate unjust systems (e.g., living in an area surrounded by fast food instead of healthy food options) by making the best choices from within the confined environment (e.g., “do more exercise,” “find the healthiest things” on the menu). He expressed the idea that individuals had agency to “find other options” and thus, counter the negative impacts of the limited options available.

Similarly, Ronald, who identified as Black/Caribbean, discussed societal and structural injustices experienced by people of color:

It's a tough world that we live in, for people like us and even if I'm Caribbean, I'm still Black and that's all some people care about. If you are Black you will not get this, you can only get that, stay down here, do not go up there, do not go over here, you are not allowed there.

Ronald expressed a nuanced understanding of how discrimination shaped his and other Black people's trajectories in the United States in terms of what people get (“you won't get this”) and where they are allowed to exist (“you're not allowed there”). However, similar to Lucas, when it came to health inequities, the narrative of individual agency was strong: “So it comes down to motivation, personal choice, and things like that.” He expanded on his sense making:

What affects your health the most is your own personal choice, because I live around a lot of fast food restaurants, but there's also places like [grocery store chain] and small community grocery stores that sell fruits and vegetables. Because of the way that I was raised, I do not really like that stuff. I was raised to eat mostly vegetables, rice, chicken, and the healthy foods, not the processed foods.

Here again, the narrative of personal choice and individual agency dominated. Ronald layered in the notion of family values (“the way that I was raised”) suggesting that eating good or bad food was about morals and choices rather than access even when faced with inequitable options (i.e., living around a lot of fast food). The concept of “motivation” and individual agency was a throughline in Ronald's experience. He expressed the same perspective about family values in the class where health, power, and food access were discussed (“I live around fast food and don't eat it”). He described how this shaped his trajectory: “I'm my own person, and I can achieve whatever I want as long as I try and give my best and even sometimes your best is not enough. You just have to keep trying and trying, until you get it.” In his statement, Ronald acknowledges that sometimes his best effort is “not enough” and yet he must persist. In doing so, Ronald leveraged narratives of personal choices perhaps as a form of resistance and resilience.

This tensions expressed by Lucas and Ronald highlight the challenges, limitations, and impacts of dominant societal narratives of individual agency. On one hand, their experiences underscore how Latinx and Black communities experience injustices at the intersection of race, place, and health (e.g., the environments where they live, foods they do/do not have access to, how their communities are seen by outsiders). Further, Lucas' and Ronald's sense making highlights the power of dominant narratives that assert equal effort generates equal gains, when in reality stark structural inequities make this disingenuous comparison impossible. Yet, on the

other hand, this is their lived realities. Lucas and Ronald's assertions of personal choice could be a necessary form of resistance, agency, and a means to find possibility to overcome and persevere in the face of the injustices they experience and must navigate.

### 5.3.2 | Income inequality: Problematizing personal choice

Some students including Lorenzo, an undocumented Mexican student, problematized the idea of individual agency and highlighted inequities in who has a choice during their sense making. When he described his participation in the summer program, his experience of racialized societal narratives emerged:

It feels good because it's one of the ways to not be one of those stereotypes that people tell you like, 'oh, see that Mexican right there, he's about to go buy something, he's about to go buy liquor, he's about to go do drugs. Their family can't do anything.' Like it feels good because you are doing something useful for your life. And you are not fitting into the categories that other people are putting you into.

Lorenzo described that it "feels good" to be in the program because it provided an opportunity to actively resist and counter the racialized narratives placed on him and people from his racial group ("categories that other people are putting you into"). However, despite his experience of navigating racialized societal narratives, at first, Lorenzo, like Ronald and Lucas, described personal choice as the most important factor: "Even you could, your community, if you don't get the support from it, you can always try to find support somewhere else." Much as Lucas stated that people could "find other options," Lorenzo described the option to leave his community in order to access needed resources. However, after further reflection, Lorenzo expressed how income determined the choices available: "You might try to eat healthy but let's say you're homeless, you don't have any money, even if you try to ask people for healthy food, they're just going to see you as the bum out in the street." Through his sense making, Lorenzo reflected on the idea that due to structural limitations, not everyone has access to the same choices. Further, socioeconomic status determined opportunity and shaped narratives about people and how they were seen and treated by others ("just going to see you as the bum on the street"). In his sense making, he integrated his experience of the racialized ways he felt portrayed as a Mexican and the narratives people placed on him with how he perceived someone who is homeless might feel. Lorenzo described his perspective of people who made bad choices if income wasn't a factor: "If you have the money and you're just not using it wisely and eating like all those, bunch of fast foods, unhealthy stuff, then you're just wasting it." Lorenzo settled on the perspective that income determined who has a choice.

### 5.3.3 | Race and racism determine health outcomes

In contrast, some students described race and associated power structures as the most significant factors determining health outcomes. For example, Gabriella, a Chicana student described a sophisticated understanding of power in a racialized society: "It's just how society is built, like they built a system on racial groups, or whatever, skin color." She described how this racial structuring shaped educational access and opportunity:

It depends on where you fall in because if you are Mexican you'll be told to get out of school and work, and if your Black you'll be told that you are gonna like go on the corner, and if you are white you are gonna be told you'll do good in school.

Gabriella expressed an unspoken, yet explicit racial hierarchy she experienced and the messages she received in school about where she belonged. She expressed the limitations that a societal racial hierarchy presented in communities like hers: "They already built it, so you have to live in it." She described her perspective of health inequities: "I think it's the race that you are because your race determines how much money, where you live, what food is available to you, what kind of education you're gonna get, so your race, it kinda determines it." Gabriella expressed that race determined access and opportunity in the United States from the physical structuring of communities ("where you live") to educational opportunity ("what kind of education you get") to healthy living conditions ("what food is available"). In this way, she extended the impacts and outcomes of the racial hierarchy she described to access and opportunity far beyond education. Further, Gabriella expressed how community structure and agency are linked and not set up for communities of color to thrive.

Similarly, Naomi, who identified as Black, viewed race and systemic racism as determining all other forms of access and opportunity. She strongly identified as a science person and wanted to pursue a career in the medical field. She was aware of racial disparities in science fields: "It's not super common for people of my race to be involved in science, but I feel that in no way means that I can't be involved in science." Naomi applied her love for science to make sense of the "information she gathered throughout her life" about health disparities: "I kind of want to blame, but not blame society. Because you know it is technically society's fault things are the way they are." In her sense making, she placed health impacts in a broader context of racism. Further, she attempted to understand racism through a scientific lens:

We've singled out people by their race, by their religion, by their sexuality, you know like those aren't the kind of differences that are going to affect the way our species is moving forward in life. Nobody really cares what skin color people have, that's not going to affect us, but it seems we have started to believe it has or something.

Naomi's sense making included sophisticated relationships between evolution ("the way our species is moving forward"), race, and racial discrimination and other forms of oppression. She was perplexed by racist notions that racial diversity was somehow hindering progress because it did not make sense from a scientific perspective:

I feel like we have taken it to an extreme where any differences are a bad thing which is not actually true. You know Darwin's theory actually absolutely makes sense, but when we start taking it to the extremes, I'm not sure what it is exactly in us that makes us see things like race.

Adding layers to her robust sense making, Naomi attempted to reconcile Darwin's theory of evolution with the perspective that "differences are a bad thing," specifically racial difference. From a scientific standpoint, differences drive adaptation and evolution. She expressed confusion about why humans are able to "see race" and asserted that seeing race as negative (i.e., racism) was "taking it to the extreme." In doing so, she attempted to reconcile the racist

views held by eugenicists, Darwin's contemporaries, and debatably Darwin himself, with present-day forms of systemic and societal oppression.

In terms of health, Naomi described a complex intersection of factors: income inequality, societal views, community structuring, and race and racism. "I'm moving more towards income inequality, because when we looked at the graphs, there are these big gaps between us (United States compared to other developed nations) causing all these health problems because everybody is stressed out and there's no real unity." She described relationships between "stress," "health problems," and collective structural support ("real unity"). Further, she went on to express that income inequality did not really get to the "root" of the problem: "Statistics about income and how that all relates doesn't really get down the root of it, but it is important to know those kinds of things and make those correlations." She expanded on what she meant by the root of the problem: "I mean like if you think of the problem of racism, it's not going to be explained by statistics of low-income people of color getting obesity more, like that's not going to explain it." By the end of our conversation, she built on her sense making further and landed on the following: "I think society affects your health the most because that's the one thing you really can't control. Where society puts you kind of majorly determines where you're going to end up." She expanded further to explain how race factored in: "Race definitely fits into a good sum of that. It will affect where you get economically, where you get even physically, people kind of push people into different places to group them off."

## 5.4 | Constructing counter-narratives: Community and future-oriented practices

Students' sense making illustrates the sophisticated and complex learning that took place in a health unit, the tensions that surfaced, challenges youth navigated, and the possibilities for disrupting narratives of people and places.

### 5.4.1 | Navigating conflicting narratives

Students' experiences highlight the challenges of engaging in structural inequities and community health outcomes in a racialized society. Felicia was challenged by supporting students in understanding how structural limitations shaped community agency:

I have a lot of trouble getting the broader structural aspect of things across to my students. Students see themselves able to make choices, but do not understand that it's because they got to this level, they are already at this level. What about the marginalized communities that do not have the educational opportunities, same access? Not everyone can make these choices.

Felicia described the impact of pervasive "personal choice" narratives on student sense making in a society that promotes meritocracy and values individualism, yet where access to opportunities is highly inequitable. "Propaganda is filled with the idea that it's personal choice, you choose your diet, determine your health. It's engrained in American society. It's up to you if you're healthy or not. If you're not healthy, it's your own fault." Navigating this tension was apparent in the sense making of students like Lucas and Robert who leaned heavily on

narratives of personal choice. In addition, she reflected on the challenges of locating herself in the statistics and data representations: “I can say that Black women are more susceptible to HIV and more susceptible to breast cancer and all these things but it’s still in my head hard for me to be, like ‘oh yeah, well that’s me.’” She expressed understanding of students’ positioning: “Being a student of color myself, and reflecting on where I was, it was hard for me to connect to community health results and so I can see how my students can still rely on personal choice.” She described the complexity of this navigation:

Even when my students have family members who are dealing with diabetes it’s hard to be like, ‘oh wait, that’s me, that’s more susceptible to get diabetes.’ It’s just like a natural defense mechanism or something. It’s hard to connect to those things I think. I wish there was more a way to be like, no when I say community, I mean you and your family.

Felicia described the challenges of supporting students in understanding how broad structural injustices limited community agency. Felicia expressed a shared understanding of having difficulty locating herself and her community in the statistics. She expressed an understanding of the difficulty of reconciling the impacts of structural racism on the health of her community, and described this as a “natural defense mechanism.” She suggested that it would help if the approach she used in the science program was taken up in high school: “They don’t learn about structures in high school, I didn’t get that until college. I hope that some little seeds are getting in there!” Here, Felicia expressed that a critical inquiry of societal and structural inequities, the history, impacts, and outcomes would help challenge pervasive notions of individual agency.

#### 5.4.2 | Reimagining possibilities for community agency

Felicia served as a role model for students. When asked who they met during the summer program that they would consider a scientist, all of the students interviewed named Felicia. Gabriella described how having a Black teacher shaped her perspective about who does and can do science:

Knowing that she’s Black and she’s smart and she’s a female, it did not surprise me, I was just like before (pre-program interview), like I know that people can do certain things and everyone has the same, mind or whatever. So, it’s just like me saying that, ‘oh you could be this you could be that,’ but then like actually seeing it, that’s cool.

Gabriella described how her conception that anyone can do science was validated by having Felicia as a teacher. It was meaningful to her to have empirical evidence. Interestingly, she described Felicia as “smart.” Perhaps this form of navigation was particularly important for her in the world of STEM where conceptions of ability and intelligence are highly racialized.

Aligned with Felicia’s goals, the theme of community, unity, and collective agency came through as a solution or way to address disparities in who is involved with science. For example, Naomi, described an idea:

I think the biggest thing would definitely be to try to reach out to my community because the closer people are to you, the more they are going to trust you. If I start reaching out to people in my neighborhood or school, then they'll have more connections to peoples a little bit farther outside and it'll just kinda spread like a water ring.

Naomi talked about the importance of encouragement: "People feel really not needed or cared about it seems and I want to change that." She hoped to build trust and support others. Felicia hoped the unit instilled confidence in students about their ability and potential as learners and doers of science, and critical thinkers about their world moving forward:

I would love for the students to have support and confidence in themselves. One thing about STEM fields is that it's like you are either smart or you are not smart, you are either supposed to be here or not supposed to be here, and if you can have, just build that confidence about yourself, your desire, your own place in science, because in my class you have been doing science, clearly you belong here.

Felicia described how she would improve her instruction: "There's so much more that I wish I could do, if we're going to talk about racism and sexism in like health then we should be able to talk about the histories of racism and sexism." Felicia described the importance of historicity in science, emphasizing the importance of understanding history in order to make sense of the present:

Not taking certain things for granted in biology, medicine especially, and recognizing that everything needs to be evaluated and you cannot objectify anything really. Everything has history and knowing where that history comes from, I think allows you to leave more space for people and caring for people more fully.

Through this history, she connected notions of race and racism to present day outcomes and narratives about health. Felicia underscored the importance of historicity for thinking critically and understanding communities more fully and as a means to foster compassion and care.

## 6 | DISCUSSION

In this study, I explore what community-driven science looks like in a science classroom through a biology unit that engages health equity at the intersection of history, race, place, and power. Further, I explore how the community health unit shaped students' sense making and supported them in reimagining community narratives. In this section, I expand to also explore how this approach can shape community-driven science research and teaching moving forward.

### 6.1 | Community structure and agency: History, race, place, power, and health

Felicia's curricular design and approach to the health equity unit shaped engagement in science practices, the knowledge and practice of the learning community, and how students made sense of community health outcomes in important ways. Exploring community structure and agency through a socio-historical, political, and relational lens illustrated the tensions between

dominant forms of relationality in a capitalistic society (e.g., individual agency), pervasive racialized narratives about communities of color, and policies and practices that impact and limit their opportunities to thrive. Based on her lived experiences and orientation to community-driven science, Felicia engaged students in these tensions in authentic ways during the health equity unit. As a result, students' sense making reflected, directly, the complexities of navigating incongruent narratives of individual agency and the realities of health outcomes in minoritized communities, as well as their resilience in the face of oppressive structures. The tensions that emerged raise questions about what it would mean to achieve true community liberation and how this informs community-driven science research, teaching, and learning moving forward.

### 6.1.1 | Importance of a critical pedagogical vision in community-driven science teaching

Exploring Felicia's orientation to community-driven science through a community health unit expands the terrain for student empowerment and agency in science education. Felicia's lens as a Black woman scientist mattered (Nasir, 2004); it shaped her political clarity around issues of health equity, vision, and instructional and pedagogical approach to community-driven science (McKinney de Royston, 2020; Watson, 2018). This study expands understanding of a pedagogical vision where an educator's background shapes the possibilities for students projected into the future (Cole, 1996; Nasir, 2004). Findings illustrate the critical layers Felicia brought to community-driven science in the classroom through her positioning and by engaging the socio-political tensions of societal conceptions and structural inequities associated with community health (McKinney de Royston, 2020; Watson, 2018). First, based on her lived experiences and training, she challenged students to question dominant narratives of places, people, and forms of relationality that negatively impact community agency. To do this, she engaged the intentional and unjust structuring of communities over time and context (Rothstein, 2017; Villarosa, 2021). She centered critical inquiry and data analysis of the impacts of unjust policies and practices on the health outcomes for communities of color. Second, she centered unified forms of relationality in the classroom that directly contrasted with dominant forms of individuality in society that she sought to problematize and disrupt. Felicia created a safe, inclusive, caring learning community because she understood it was an essential foundation for critical inquiry and analysis to take place. Felicia positioned herself as a member of the learning community and modeled vulnerability by placing herself in the statistics, a key feature of relationship building found by Watson's (2018) analysis of Black women educators. She promoted social closeness and critical care (Nasir & Bang, 2020; Watson, 2018) by physically moving the class so they were in close proximity to each other and described the social relations of the class as "family" (Nasir, 2004). Through this approach, she presented a future-oriented model of community organization, illustrating how communities can thrive through collective care and action. Third, Felicia explicitly elicited and leveraged youths' cultural practices and lived experiences as instructional resources and as central to the "doing" of science.

### 6.1.2 | Community-driven science practices: Disrupting dominant narratives in science

Findings from this study build on research that promotes multiplicity in science by framing expansive forms of sense making, cultural practices, and epistemological contributions as

scientifically valid (e.g., Bang et al., 2017; Calabrese Barton et al., 2020; Nasir et al., 2006; Warren & Rosebery, 2011). The community-driven science approach that Felicia employed viewed youths' lived experiences and assets as central to not only their sense making but the doing of the science practices themselves. That is, in addition to expanding what counts as a science practice (e.g., Warren & Rosebery, 2011), Felicia's critical approach viewed the lived experiences and analytical lens of youth of color (McKinney de Royston, 2020; Watson, 2018) as central to the "doing" of science practices. In this way, students both engaged in science practices and authored their own forms of using the tools. Thus, in a community-driven science context, approaching the doing of science practices in ways that centered youths' lived experiences and lens on the world, disrupted power structures and promoted youth agency (Calabrese Barton et al., 2020). Her approach directly connected to the critical and expansive perspective of science that Felicia developed in college as a Biology and Africana Studies major. Further, underscoring the role and importance of their lens as youth of color/researchers promoted critiques of "objectivity" in science (Harding, 1995) and centered the authentic understanding that a scientist's lens matters for what is studied and how it is done (e.g., research questions asked, methods employed). Community-driven science practices supported youth in interrogating pervasive societal narratives about health in communities of color. Further, through critical inquiry that contested dominant forms of relationality pervasive in the U.S. and STEM education (e.g., individual, competitive, exclusionary), Felicia problematized how unjust community structuring limits collective agency.

### *Promoting youth agency*

The implementation of community-driven science practices offers a necessary expansion of how science practices are typically engaged in science education such as in the Next Generation Science Standards (State Leads, 2013). To support youth agency during the health equity unit, instructional and pedagogical resources were made available when engaging in science practices in a community-driven science context. Relational resources such as development of a close, caring community, positioning students as capable learners, and recognizing their lived experiences as valuable contributions to their collective learning (Calabrese Barton et al., 2020; Watson, 2018) provided an important foundation that supported youths' engagement in science practices throughout the unit. Felicia created opportunities that instilled confidence in students about their science ability that repositioned them as capable science learners and doers. Further, throughout the unit she positioned students as co-conspirators who asked questions, collected empirical data for their investigations, and engaged in sophisticated sense making in ways that promoted youth agency. Critical data analysis of graphs, tables, and other data representations of health statistics and outcomes fostered sense making about health outcomes based on race, gender, and socioeconomic status. Further, at the intersection of community structure and agency, Felicia reminded students to notice assumptions and biases as they explored data (e.g., who should get a certain disease more). Engaging in data analysis through a critical lens and at these generative intersections provided an opportunity for students to begin the process of disrupting long-standing, pervasive single stories of place, specifically their communities, in order to reimagine multiple place-stories (Adichie, 2009; Love, 2019; Taylor, 2018; Watson, 2018). Together, engaging students in these science practices, through these critical intersections, in this community-driven science classroom, humanized science practices in ways that centered dignity and respect (Espinoza et al., 2020).



### *Supporting student sense making*

Students' sense making about structural inequities and agency was sophisticated, dynamic, complex, and revealed the impact of dominant societal narratives on the forms of navigation students viewed as available. Further, it directly reflected the tensions between structural inequities and community agency. The tensions were particularly apparent when making sense of racialized narratives about community health, health outcome data, and students' experiences in their own communities. Students commonly asserted individual agency, the dominant form of relationality in the United States, as a means to overcome systemic and structural injustices. For example, Ronald described living among fast food restaurants with limited access to fresh produce. Yet, he maintained that being healthy was about personal "motivation" and values. He made sense of this by asserting that he could make the best choices given the limited options. Similarly, Lucas described how you maintain your health as a personal choice. This directly aligns with common racialized assumptions about "effort" and work ethic highlighted by Villarosa (2021) that render systemic injustices invisible. These forms of sense making illustrate resilience in the face of oppressive structures. However, they also demonstrate the strength and reproduction of racialized narratives that blame communities of color for the circumstances in which they have been forced to live and blame individuals for making "poor choices" even though access is inequitably distributed. Through students' sense making, the shortcomings of dominant forms of relationality in a racialized society became apparent. These narratives stand in stark contrast to collective aspects of community agency; a requirement for them to actually thrive.

The complexity of students' sense making and the tensions they expressed raise questions about what it would mean to transform communities to center justice, humanity, and dignity. Currently, constructing counter-narratives requires a separation of community structuring, which is designed to be intentionally inequitable, from the people who live in them (Rothstein, 2017; Villarosa, 2021; Williams, 2020). Further, it requires the disruption of dominant forms of relationality (i.e., individual agency, personal choice) in a capitalistic society.

## **6.2 | Future-oriented community practices: Healing, hope, resilience**

In the beginning of the paper, I posed the following question: "What if science was a tool youth used to reclaim their community-stories and reimagine future possibilities?" Findings from this study highlight the need to engage in complex intersections of history, race, place, power, and health with students in and outside of science classrooms. It was through supporting and engaging students in the complex intersections of community structure and agency that Felicia created an opening for disrupting deficit-oriented narratives of community health.

When viewed through the perspective of critical science pedagogy (Calabrese Barton et al., 2020; Morales-Doyle, 2017), students' strategies can be seen as diverse forms of resistance, resilience, and attempts to reclaim multiple stories of their communities, namely *their* stories. Through her political clarity and by grounding her teaching and learning environment design in the socio-political and historical context of community-driven science, Felicia elevated the importance of history to understanding present structuring of place, promote humanity and dignity, and as a way to foster hope and possibility. In a learning environment where the strengths of students' food cultures were valued and built on while they learned to use science as an agentic tool, students gained authorship of their community stories. For example, Naomi's attempted to make sense of the "root" of the issue of health disparities and racism, instead of

simply engaging the outcomes (i.e., the end of the story). Importantly, this move can be seen as a bid to determine the narrative of her community story, from the beginning, and to construct expansive narratives of place. She viewed a lack of unity in a society where people did not feel cared about as contributing to disparities in health outcomes. Adichie (2009) speaks to Naomi's desire for authorship:

I've always felt that it is impossible to engage properly with a place or a person without engaging with all of the stories of that place and that person. The consequence of the single story is this: It robs people of dignity. It makes our recognition of our equal humanity difficult. It emphasizes how we are different rather than how we are similar.

Naomi described a way forward that promoted community as a place of closeness and care, that fostered trust; where people believed in and supported each other in realizing their dreamscapes.

Felicia promoted asset-based approach to community by eliciting students' cultural practices and traditions around food. This approach presented another way of doing and being in community and served as a future-oriented practice of reimagining possibilities for community structuring that provided opportunities to thrive. Throughout the unit, problematic single stories about community were disrupted (e.g., making unhealthy food choices), and when layered in with new understandings of intersections of race, place, and socioeconomic status, generated multiple place-stories about community grounded in their resilience and strengths (Bang et al., 2017; Calabrese Barton et al., 2020; Taylor, 2018; Watson, 2018). This created an opening and an opportunity to construct counter-narratives and reimagining of place. Through this process and engaging in empowering curricula that built on students' brilliance and lived experiences, youth were positioned as transformative intellectuals (Davis & Schaeffer, 2019; Morales-Doyle, 2017).

As with most educators (certainly any class I have ever taught), Felicia expressed a desire to do much more than she had time to do. Central to her reflection was the importance of history as a way to leave more space for people and care for people more fully. In this way, she expressed a desire to create an opening and leave space for reclaiming, reimagining, and promoting healing and hope. There is power in understanding multiple stories of the past, histories of people and places. Taylor (2018) describes how walking through her hometown and the resulting construction of multiple-place stories transformed how she thought about her community, her experiences, and the people that lived there. Adichie (2009) adeptly expressed the power of multiple-place stories: "When we reject the single story, when we realize that there is never a single story about any place, we regain a kind of paradise." By empowering students to use science as a tool for critical inquiry and analysis, Felicia created the context for the emergence of multiple stories of community and a launching point for transformation of people and place.

### 6.3 | Implications

Findings have implications for community-driven science teaching, learning, and research moving forward. Findings show that in order to be responsive to youths' sense making and lived realities, the intentional and unjust structuring of communities in the United States must be

addressed in and outside of community-driven science contexts. Felicia's critical pedagogical vision, including her lived experiences, perspective of science, and how she saw her students mattered for the instructional design of the health unit and the student outcomes generated. Findings call on science teacher preparation and professional learning programs to engage science teachers in intersections of history, race, place, and power as it relates to science teaching and learning. Broadening opportunities for participation in science for students historically excluded requires critical engagement in the socio-historical and political aspects of science education. However, in my experience as a science teacher educator, and instructor for the secondary science methods course in the single subject credential program at my institution, during a community/place-based section of the course, when I ask teachers (post-baccalaureate) about the discriminatory practice of redlining, most often, no one has heard of it. As a divisive political climate stokes fervor over "patriotic" history in an attempt to undermine efforts to engage all of our nation's history, it is important for science educators to reconcile how communities have been structured and how this intersects with science concepts and phenomena. The health equity unit provides a model of engagement in community-driven science practices that disrupted power structures and dominant narratives in science education. Promoting youth agency by viewing youths' lived experiences and cultural practices as central to the "doing" of science practices expands the typical uptake of science practices in the Next Generation Science Standards. Further by promoting forms of relationality that honor the power of collective uplift and action, community-driven science can support the reimagining of community stories while centering humanity, dignity, and respect.

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## ENDNOTE

<sup>1</sup> All names, instructor and students, have been changed to pseudonyms to protect the anonymity of participants

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