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How Can Principles of Culturally Sustaining Pedagogy Inform the Design of a Junior High Curriculum to Enhance Science Learning in a Meaningful Way?

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HOW CAN PRINCIPLES OF CULTURALLY SUSTAINING PEDAGOGY INFORM THE DESIGN OF A JUNIOR HIGH CURRICULUM TO ENHANCE SCIENCE LEARNING IN A MEANINGFUL WAY?

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ABSTRACT

HOW CAN PRINCIPLES OF CULTURALLY SUSTAINING PEDAGOGY INFORM THE DESIGN OF A JUNIOR HIGH CURRICULUM TO ENHANCE SCIENCE LEARNING IN A MEANINGFUL WAY?

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The objective of this dissertation was to explore how the principles of culturally sustaining pedagogy (CSP) can inform the design of a junior high school curriculum to enhance science learning by providing meaningful learning experiences to all students. The transformative paradigm provided a framework used as a lens to emphasize the importance of understanding the social, cultural, and historical context in which individuals and communities are situated. CSP and Backward Design Model were applied to develop a curriculum for a sheltered science literacy elective class for below grade level readers. The purpose of using CSP in the curriculum design was to create a more inclusive and culturally sustaining learning environment that would support students in developing strong science literacy skills. Project–based learning (PBL) was used with CSP to allow for flexibility and creativity in project designs that give students the opportunity to explore and experiment with different ideas and approaches in the learning environment. The California Department of Education's descriptions for effective use of CSP in a classroom was incorporated into the curriculum to be used as an assessment tool measuring the effectiveness of the curriculum. The implications of this curriculum development suggest the effectiveness of CSP on science literacy and its connections enhance student performance in science. This dissertation is available in open access at AURA: Antioch University Repository and Archive, https://aura.antioch.edu/ and OhioLINK ETD Center, https://etd.ohiolink.edu/.

Keywords: academic intervention, Backward Design, culturally sustaining pedagogy, diversity, equity, instructional practices, project–based learning, science literacy, science teacher, sheltered science, social justice

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우리 엄마에게. 내가 너를 생각할 때마다, 내 마음은 사랑으로 가득 차 있습니다. 이건 당신을 위한 거예요.

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CHAPTER I: INTRODUCTION

Problem of Practice Statement

A running theme throughout U.S. history is there has always been a group of people whose voices have been given more weight and authority than others (Liu, 2017). This reality perpetuates racism and discrimination, creating a perception of low social positioning because of a person's ethnic and cultural identity. The effects of racism and discrimination can be seen through economic, social, and cultural inequalities marginalized groups of people experience in our society.

School settings are microcosms of our communities in which the educational system socializes students into their communities (Dewey, 1913). Cultural expectations and norms are reinforced by teachers, the books educators use in classrooms, and with interactions among classmates (Gay & Kirkland, 2003). These implications (Gay & Kirkland, 2003 can create feelings of oppression with students who identify as Black, indigenous, people of color (BIPOC) and/or fall into the poverty or low socioeconomic status of our community and the schools that serve them (Banks, 2019).

The factors previously stated influence whether students will be on the wrong side of the science achievement gap by limiting their opportunities for advanced level of instruction (Blake & Pope, 2008). Subsequently, cultural expectations and norms reinforce the social inequalities and inequities of our education system. These implications create a further burden on our existing systemic problems in science education by initializing a domino effect as students matriculate from middle school to high school, with potential effects for postsecondary education.

These outcomes are reflected in the limited choices students have for advanced level science courses during their high school and college years. Limited access to advanced levels of content specific courses could potentially hinder students' career opportunities in the professional science and technology fields (Phillip & Azevedo, 2017).

The objective of this curriculum was to explore how educators can use culturally sustaining pedagogy (CSP; Paris, 2012) to dismantle the dominant social constructs and discourse perpetuated by school communities. Educators are encouraged to acknowledge and accept each other's diverse racial and ethnic identities, hence honoring students for their whole selves and all their connected experiences, including students who are identified as socially marginalized, and incorporating their stories into the classroom curriculum.

School communities can be places where socially marginalized (Berry, 2010) students experience a lack of recognition and acceptance. Socially marginalized students are defined by the social constructs of their school communities. Nonrecognition and unacceptance of their culture and self–perceptions consequently mutes students' identities and perpetuates their oppression (Berry & Candis, 2013). For multicultural students, this often means suppressing pieces of their cultural identity just to fit in at school. Awareness of the differences in cultures is a step towards valuing diversity to enhance the cultural competence of a school community.

Personal Relationship to the Topic

My whole reason for being a teacher is to empower students with the ability to take risks by acknowledging when something does not seem right or just and be brave enough to make assertions to achieve positive changes in their communities for the betterment of everyone (Alim & Paris, 2017). My drive as a teacher is to "educate to liberate" (Block, 2015, para. 1) and give a voice to all students, especially those identified as students in marginalized groups.

In order to honor my students' experiences, my primary task is to focus on how I can have a thoughtful classroom setup and structure so I can make learning meaningful and transformative (Paris, 2012). This fuels my commitment as an educational practitioner. My students' wants and needs, and their ability to attain them, come first.

Non–discrimination and equality in education are basic human rights. In my nineteen years of teaching, I have witnessed the right to education be exclusive (Banks, 2019). I have learned of many students facing challenges of equal opportunities for all in accessing education within our educational system. Marginalized groups are often left behind by our educational policies (Mertens, 2009). This denies students the right to an equitable education which runs counter to my deeply held philosophy of teaching.

My philosophy of teaching is grounded in transformative learning (Mertens, 2010), which involves creating dynamic relationships with students, and a shared body of knowledge to promote student learning and personal growth (Gonzalez et al., 2005). Creating this collaborative environment, I encourage students to become meta–critical thinkers (Caraballo, 2016) in the learning process by practicing critical thinking, goal setting, and reflection. I facilitate my students' self–identity and collective identity in the classroom by asking open–ended questions to promote critical thinking skills that will help learners relate new knowledge to their own life experiences (Paris & Alim, 2017).

Research Question

The inquiry that drives my curriculum development is as follows: How can principles of CSP inform the design of a junior high school curriculum to enhance science learning in a meaningful way to all students?

Purpose Statement

The purpose of this curriculum development study was to explore how teachers can offer students equitable access to their science instruction as culturally sustaining educators and embody these best practices in a science literacy course using CSP (Paris 2012). The motivation behind the study was based on the premise every student has a unique cultural background, which should be acknowledged, validated, and integrated into their education. This study is of significance because CSP advocates for an inclusive and equitable approach to education that acknowledges the diverse experiences, languages, and identities of students. CSP encourages educators to create learning environments that foster positive relationships, promote critical thinking, and empower students to explore their cultural heritage and share their knowledge and experiences with others.

Significance of Study

CSP (Paris, 2012) holds great significance in the classroom as it promotes inclusive and equitable educational experiences for all students. CSP promotes cultural affirmation, student engagement, academic achievement, multicultural competence, social justice, and community engagement. By embracing students' cultural backgrounds, CSP creates a more inclusive and empowering learning environment where all students can thrive and reach their full potential.

The objective of this dissertation was to explore how educators can use CSP (Paris, 2012) to dismantle the dominant social constructs and discourse perpetuated by school communities. CSP encourages educators to acknowledge and accept each other's multidimensionality (Berry, 2010), hence honoring students for their whole selves and all their connected experiences, including students who are identified as socially marginalized, and incorporating their culture and ethnicity into the classroom curriculum.

School communities can be places where socially marginalized students (Berry, 2010) experience a lack of recognition and acceptance. Socially marginalized students are defined by the social constructs of their school communities. Nonrecognition and unacceptance of their culture and self–perceptions consequently mutes students' identities and perpetuates their oppression (Berry & Candis, 2013).

CSP challenges the traditional deficit-based models of education (Alim & Paris, 2017), which assume students from diverse backgrounds need to abandon their cultural practices and conform to the dominant culture to succeed academically. These models assume students from certain backgrounds or with certain characteristics are inherently disadvantaged and have deficits that need to be remedied through targeted interventions (Valencia, 1997). Following this model perpetuates stereotypes and stigmatizes students who are already marginalized, including students from low–income families, students with disabilities, and students from minority groups.

In contrast, CSP is a strength-based model of education (Lopez & Louis, 2009) focusing on building upon the strengths and assets of students, recognizing every student has unique talents, interests, and capabilities. By focusing on these strengths, teachers can create a more positive and inclusive classroom environment that promotes learning and success for all students.

As a teacher, I consistently grapple with how to protect students from racism, bias, and discrimination. My experience in teaching middle and high school science has taught me prejudice and racism can be imposed on anyone. Immediate redirections in class are just a quick fix to alleviate present conflict. Interventions with school counselors can foster more inclusive representation through support groups, mentoring programs, and student workshops that address the unique challenges faced by marginalized students, such as racial or ethnic minorities,

students with disabilities, or students from low-income backgrounds (Hernandez & Seem, 2004), and LGBTQ+ students (Madireddy & Madireddy, 2020). But the effects seem short term. Being explicit with our language and recognizing the diverse cultures and self-identities can offer more sustaining outcomes to foster equity beyond the classroom.

CSP promotes equality across racial and ethnic communities, while creative discourse creates opportunities for people to make personal connections through narrative storytelling. This multi–layered framework serves as the foundation for this project and frames the literature in the field of education, explored in the following section.

Creative discourse is a method in which educators can implement this strategy using narrative storytelling (Berry, 2010). Narrative storytelling allows educators to center the conversation for those who are socially and politically marginalized by the dominant culture. The inclusion of narrative storytelling allows for students who are identified as members of the socially marginalized group to dismantle the dominant narrative to create shared realities more inclusive to all individuals.

Narrative storytelling (Berry, 2010) has the potential to be a valuable tool to enrich a lesson by providing a more meaningful and engaging learning experience for students. Personal narratives allow students to connect with the experiences of others and develop empathy. This can help students to understand and appreciate different perspectives and cultures. This can make the learning more relevant by showing how the concepts or ideas being taught apply to real-life situations, allowing for students to engage more deeply with the material.

Being intentional with our language is an instrumental component in creating opportunities for promoting social inclusion to help connect and unite diverse students. Being proactive in using specific language that honors and accepts the identities of our students

empowers students' voices (Zacko-Smith & Smith, 2010). Socially inclusive language recognizes respectful terminology for people from diverse groups and invites people to share their pronouns. Intentional language offers students an opportunity to be seen, understood, accepted, and valued in their school communities.

Incorporating intentional language in narrative storytelling within a culturally sustaining curriculum is an effective way to honor and respect diverse cultures while fostering inclusivity and empowerment. It is a way to celebrate students' cultural identities and promote social justice. By incorporating diverse perspectives and respecting cultural nuances, teachers can create a curriculum that affirms the identities and experiences of all students.

Limitations & Delimitations

CSP is an approach to curriculum development that seeks to maintain and build upon the linguistic and cultural practices of students from historically marginalized communities. While this approach has many strengths, there are also some limitations. Limitations anticipated during the process of creating this curriculum are as follows: access to prior research, diversity within the community, limited scope, assessment of CSP's use in the curriculum, and funding.

Limited access to prior research was the most challenging limitation. There seemed to be a gap in the literature for studies using CSP in middle school science classrooms. Instead, articles based on Culturally Relevant Pedagogy, its previous theoretical model, were mostly present. Again, there is limited access to studies that have implemented Culturally Relevant Pedagogy (CRP) in science classrooms as well. Although this may be true, I plan to apply the tenets of CSP within science classrooms to create new knowledge in science from the existing one.

Even within a single community, there can be significant diversity in language, culture, and practice. Developing a curriculum amenable to all these diverse practices can be challenging, and educators must be careful not to homogenize or stereotype the community.

While CSP can be effective in helping students feel valued and seen in the classroom, it may not be enough to address broader issues of systemic inequality and marginalization. For example, a culturally sustaining curriculum may not be sufficient to address issues of racism, sexism, or economic inequality that students face outside the classroom.

It can be challenging to assess the effectiveness of a CSP curriculum. Traditional assessments may not be appropriate for evaluating the impact of a culturally sustaining curriculum. Educators may need to develop new assessment methods more aligned with CSP principles.

Curriculum development is a process essential to the success of any educational institution. It is the process of creating and planning the instructional materials and activities used in a course or program of study. There are many factors considered when creating a quality curriculum, such as the resources available, the teaching staff, the learners, and the curriculum itself. An important factor that needs to be considered during this process is funding. Lack of funding can result in not having access to resources vital to the success of the curriculum. Resources include purchasing science reading books, materials for students to use in the course, and being able to pay for staffing so the course can be a success.

Definitions of Key Terms

The following is a list of key terms and their definitions significant to this study.

- *Asset-Based Valuation* in education is when educators refer to students' diversity and culture they bring to the classroom as strengths rather than limitations (Paris & Alim, 2017).
- *Backward Design* in education is the design of curriculum to meet specific learning goals (Wiggins & McTighe, 2005).
- *Critical consciousness* is when culturally sustaining educators help their students develop a critical understanding of the social, cultural, and historical contexts in which they live (Alim & Paris, 2017). They encourage their students to question dominant narratives and to think critically about issues of power and privilege.
- *Culturally relevant pedagogy (CRP)* is when culturally sustaining educators use pedagogical approaches that are relevant to their students' cultural and linguistic backgrounds (Paris & Alim, 2017). They draw on students' experiences, cultural practices, and ways of knowing to make learning more meaningful and engaging.
- *Culturally responsive teaching (CRT)* is a method of instructing students using their cultural customs, experiences, and perspectives to differentiate the curriculum (Ladson-Billings, 1992).
- *Culturally sustaining pedagogy (CSP)* is a pedagogy that utilizes the cultural customs, experiences, perspectives, and native language of students in the classroom to enhance and differentiate the curriculum (Paris, 2012). Curriculum becomes more student-centered where students use their culture and customs to guide their learning in

order to ensure that what the students are bringing to the classroom is also supported, encouraged and sustained through school (Paris & Alim, 2017).

- *Creative discourse* is a method in which educators can implement personal narratives in storytelling (Berry, 2010).
- *Deficit-based models of education* are educational approaches that focus on identifying and addressing the weaknesses, deficiencies, and problems of individual students or groups of students (Alim & Paris, 2017).
- *Equity* is the concept of fairness and justice in education, ensuring that all students have access to the resources and support they need to succeed (California Department of Education, 2022b).
- *Funds of Knowledge* refers to the idea of educators using specific family and cultural backgrounds and the lived experiences of their students to enhance their classroom community (Gonzalez et al., 2005).
- *Identity* is the complex set of characteristics that define an individual or group, including race, ethnicity, language, gender, and socio-economic status (American Psychological Association, 2023).
- *Intentional language* means to be proactive in using specific language that honors and accepts the identities of our students and empowers their voices (Zacko-Smith & Smith, 2010).
- *Linguistic resources* refers to recognizing and valuing the cultural and linguistic backgrounds that students bring with them to the classroom (Alim & Paris, 2017). These backgrounds are seen as assets to be built on, rather than deficits that need to be corrected or overcome.

- *Pedagogy* is the methods and practices used in teaching and learning (Paris & Alim, 2017).
- *Professional Learning Community (PLC)* is a term used to describe a group of teachers working collaboratively at the school level to improve student outcomes (DuFour, 2004).
- *Project-based learning approach* is a teaching and learning method where students learn by actively engaging in real world and personally meaningful projects (Krajcik et al., 2014).
- *Sheltered instruction* is an instructional approach that offers scaffolding accommodations that engage learners just above their developing grade level content area knowledge, academic skills, and language proficiency (CATESOL, 1992).
- *Strength-based model of education* is a student-centered approach to teaching that looks for opportunities to complement and support students' unique strengths and capacities in the classroom (Lopez & Louis, 2009).

By incorporating CSP (Banks, 2019) into the classroom, teachers can create an inclusive and empowering learning environment (Paris, 2012). CSP recognizes students who bring diverse cultural identities, knowledge, and ways of engaging with the world to the classroom and seeks to validate and build upon those assets. By doing so, students are provided with opportunities to develop a positive identity, connect with the subject matter, and see themselves as active participants and contributors in the educational community. The next section will discuss how integrating CSP into science education supports students in seeing themselves as capable scientists, engaging with scientific concepts from their own cultural perspectives, and developing a deeper understanding and appreciation for science.

CHAPTER II: REVIEW OF THE LITERATURE AND THEORETICAL FRAMEWORK

The following is a literature review of the intersectionality between science education and how CSP (Paris, 2012) can be applied through equitable solutions to meet every student's needs. The theoretical framework that informs my inquiry is CSP and narrative storytelling within its components of linguistic, literate, and cultural pluralism to foster and sustain cultural pluralism and cultural equality. Teacher reflections emerge as an important component of the curriculum through the lens of CSP.

CSP is a theoretical framework that centers on the idea of maintaining and supporting the linguistic, cultural, and historical assets of diverse students in educational settings (Paris, 2012). CSP emerged as a response to the limitations of multicultural education and other approaches that often view students from marginalized communities as lacking and in need of assimilation into the dominant culture.

CSP acknowledges the complexity of culture and recognizes students bring unique cultural and linguistic resources to the classroom (Paris, 2012). Therefore, it seeks to leverage and build upon these resources to promote academic success and positive cultural identity development. This framework is grounded in the idea that students' identities should be affirmed and celebrated, rather than erased or assimilated, in the educational setting.

CSP is informed by critical pedagogy and critical race theory, and it emphasizes the need to challenge and disrupt dominant narratives and power structures in education (Alim & Paris, 2017). It also recognizes the importance of building relationships and partnerships with families and communities to create more inclusive and culturally sustaining learning environments. Overall, CSP offers a powerful framework for educators to support the diverse needs of students from marginalized communities and promote social justice in educational settings.

Intersectionality refers to the interconnected nature of social categories such as race, gender, class, and sexuality, and how they interact to shape experiences of oppression and privilege (Berry & Candis, 2013). In the context of education, it is important to recognize and address the ways in which these social categories intersect to create unique experiences and challenges for students.

Culturally sustaining pedagogy can be used to make science education more inclusive and culturally sustaining. For example, teachers can incorporate culturally relevant examples and metaphors when teaching scientific concepts or draw on students' personal experiences and cultural practices to explore scientific phenomena (Paris, 2012).

The goal is to create a more holistic and integrated approach to education that recognizes and values the diverse experiences and perspectives of students. By integrating science education and culturally sustaining pedagogy, teachers can help students see the connections between science and their own lives and empower them to become more engaged and informed members of their communities.

Theoretical Framework

The theoretical framework that serves as a foundation for these commitments derives from my goal of wanting to foster a classroom environment that accepts individuals holistically while offering equitable access to the curriculum. CSP (Paris, 2012) will inform these components.

CSP (Paris, 2012) seeks to perpetuate and foster linguistic, literate, and cultural pluralism as part of the democratic project of schooling. By doing so, educators embrace cultural pluralism and cultural equality. Honoring home language, literacies, and cultural ways allows students to preserve their heritage, community cultural and linguistic practices (Moll et al., 1992).

The curriculum development study explored how educators can use CSP (Paris, 2012) to dismantle the dominant social constructs and discourse perpetuated by school communities. By identifying one's own personhood, educators are encouraged to acknowledge and accept each other's multidimensionality, hence honoring students for their whole selves and all their connected experiences, including students who are identified as socially marginalized, and incorporating their stories into the classroom curriculum.

Creative discourse is a method in which educators can implement narrative storytelling (Berry, 2010). Narrative storytelling allows educators to center the conversation for those who are socially and politically marginalized by dominant culture.

Being intentional with our language using creative discourse is an instrumental component in creating opportunities for promoting social inclusion that help connect and unite diverse students. Cultural inclusivity calls for teachers to be proactive in using specific language that honors and accepts the identities of our students and empowers their voices (Zacko-Smith & Smith, 2010). Intentional language offers students an opportunity to be seen, understood, accepted, and valued in their school communities.

In the following sections, I will explore the historical contexts of science education. I will examine how the science curriculum came into development and the standards and methodology used in its creation. The main goal of this literature review is to critically explore the science curriculum's proficiency of offering equitable opportunities to enhance all students' educational needs within the Next Generation Science Standards. An analysis of the evolution of Culturally Sustaining Pedagogy will be reviewed for use as a foundation of providing equitable opportunities in a science curriculum.

Evolution of Science Education

Historically, individual states have been left to their own devices in creating and implementing a curriculum framework for their schools (California State Board of Education, 1998; TIMSS & PIRLS International Study Center, 2015). The No Child Left Behind (NCLB) Act of 2001 (2002) changed that by regulating standards and increasing accountability on a national scale. NCLB did so by placing an emphasis on standardized test scores beginning with English and mathematics. It was not until the summer of 2011 when science received governmental guidance and support in establishing a curricular framework (Next Generation Science Standards, 2012). Until this point, students were not ensured access to learning skills about communication, analysis, and critical thinking within their school's science curriculum.

Educators develop and implement lessons and assignments designed around learning standards and determine a course's curriculum. Each subject matter has its own set of learning standards or objectives set by their school districts and the state that students need to master. Curriculum serves as the foundation to a subject matter's content area where it defines the quality of the program (Great Schools Partnership, 2014).

Interests in science curriculum propagated in the time of the Industrial Revolution in the late 19th century (DeBoer, 1991) when the importance of keeping communicable diseases, such as influenza and measles, from spreading due to the rapid increase in densely populated areas was significant (Moulding et al., 2019). Since then, the goals and focus of K–12 science education have changed based on the changing societal context (Moulding et al., 2019).

We see this shift in the demands for a more rigorous curriculum that came with having students participate in phenomenon-based learning later on in the century (Lederman & Abell,

2014). A collective acknowledgement of the poor quality of science education in schools from the scientific community became the impetus behind the science curriculum reform (Park, 2006).

Inquiry and phenomenon-based curricula is an instructional approach where teachers emphasize the students' role in the learning process (National Research Council [NRC], 2013). Students take the primary role of problem solving by encouraging students to explore the science content material, ask questions, and share ideas. The learning process takes place in small group discussions, labs, and guided instruction. The inquiry and phenomenon-based curricula is a departure from traditional, passive learning where students were required to memorize facts and materials. In science education, students learn by doing because it actively engages the student in the learning process (Symeonidis & Schwarz, 2016). Encouraging students to share their ideas fosters their curiosity and teaches skills that will allow them to continue to explore topics they are interested in.

Jerrold R. Zacharias, a physicist at the Massachusetts Institute of Technology, was the first scientist-scholar to make a specific proposal for curriculum reform in science (Tanner, 1969). The public's concern about students receiving a quality science curriculum in schools increased (Yager & Penick, 1988). Support to back the proposal was generated with the arrival of the space race and the Soviet Union's launching of the first artificial satellite, *Sputnik 1* (Hoff, 1999). The Soviet Union's win in the space race brought international embarrassment to the United States. This defeat proved fruitful in that it opened the door for the federal government to make its first financial contribution to the K–12 classroom curriculum using the National Science Foundation (National Science Foundation, 2000).

The National Science Foundation (NSF) was established in the 1950s by Congress to "promote and advance the progress of science" (NSF, 2020). The focus of advancing science has

been devoted to the improvements in science education for students with diverse ethnic backgrounds, races, and socio-economic levels at all levels of K–12 instruction (National Science Foundation, 2000). Yet, it was not until 2013 the standards for science curriculum took form with the adoption of the Next Generation Science Standards (NGSS; TIMSS & PIRLS International Study Center, 2015).

Achieve, Inc facilitated the collaborative work of the National Science Teachers Association (NSTA) and the National Research Council (NRC) of the National Academies of Science (NAS) and the National Academy of Engineering (NAE) to create the framework and standards for NGSS (National Research Council, 2013). Once published and adopted by the states, these standards began influencing science instruction in the K–12 classroom (TIMSS & PIRLS International Study Center, 2015).

The intent of the Next Generation Science Standards (NGSS) was to give "educators the flexibility to design classroom learning experiences that stimulate students' interests in science and prepare them for college, careers, and citizenship" (NGSS, n.d.). Instead of teaching many isolated facts, the goal of the NGSS was to "allow teachers to focus on disciplinary core ideas and cross-cutting concepts that could be used to explain phenomena and solve problems by engaging in science and engineering practices" (Krajcik et al., 2014, p. 157). This meant that instead of students learning science facts through rote memory, they were building and applying science knowledge through inquiry and phenomenon-based curricula.

American Astronomer Carl Sagan once said, "Every kid starts out as a natural-born scientist, and then we beat it out of them. A few trickle through the system with their wonder and enthusiasm for science intact" (Psychology Today Staff, 1996). The longer a child stays in public education, it seems the more likely that person's curiosity, passion, and enthusiasm for learning

fizzles out and disappears into a faint memory. This may be due to the lack of encouragement received by students. Traditional methodological practices implemented by teachers discourage students from meaningful learning can be the discouraging factor as well (Hatch, 2018; Kesidou & Roseman, 2002).

Traditional teaching methods have been based on the idea of the banking model of education (Freire, 2014) where students are considered the empty vessels in which teachers deposit information so students may relay the information at a later time. The NGSS took an instructional shift away from students simply regurgitating an abstract recall of facts (National Research Council, 2013). Instead, the framework encouraged educators to teach in a way that sustained students' interest in learning through inquiry and phenomenon-based learning by promoting hands-on activities (Mathewson, 2016; National Research Council, 2013).

The NGSS makes a point of clarifying the standards communicated for each grade level put forth by the committee are goals in which students should meet specific performance expectations (National Research Council, 2013). The purpose of this was to allow for teachers, schools, and districts to have flexibility in the design of their science content curricula. The main benefit of flexibility in the classroom is it allows teachers to respond to the diverse learning abilities and needs of their students. Teachers respond to their students' individual needs by differentiating their lesson plans to meet individual learning needs and styles (Gardner, 2003). Then, they implement scaffolding measures to ensure equity in that all students are successful in learning the same content (Krathwohl, 2002).

Performance expectations to measure student learning outcomes were adopted into the NGSS standards (NRC, 2013). These performance expectations hold teachers accountable for implementing rigorous instructional strategies rather than just reading and answering questions

from a textbook. Performance expectations require teachers to use inquiry and phenomenon-based projects, so they are aligned with the Disciplinary Core Ideas published in the NGSS handbook (NRC, 2013; NGSS, n.d.). They reinforce the idea students will acquire scientific knowledge and be able to apply that knowledge by thinking and using reason in a scientific manner, such as utilizing the scientific methods in everyday problem solving (NRC, 2013; Reiser, 2013).

By the end of a year's instruction, students are expected to meet a baseline standard of performance specific to their grade level (NRC, 2013). The performance expectations set the learning goals and the educator plans accordingly, to teach for their assigned grade level instruction. NGSS state linked assessments are administered in grades 5, 8, then once in high school typically during their grade 10 school year (California Assessment of Student Performance and Progress, 2020a).

The NGSS state linked assessments attempt to affirm acquired knowledge from students for multiple grade spans on a national level (Pellegrino et al., 2014). In California, the California Assessment of Student Performance and Progress (CAASPP; California Assessment of Student Performance and Progress, 2020b) for K–5 science content is administered at the end of grade 5 while grades 6 through 8 science content is assessed at the end of grade 8 (CAASPP, 2020). All the high science school standards are assessed in one test administered within most students' grade 10 or 11 school year. These grade level testing bundles serve as a check in with schools to see how well their students measure up against other students within their districts, counties, and states.

Each school district has support systems in place to further enhance its ability to meet state testing expectations (Education Code 56100, 1980). Some of these support systems include

having peer mentors, supervisors, and curriculum specialists on campus for teachers to seek instructional advice and help with implementing lessons to their specific student population. Contingent on financial resources, some districts also offer teachers opportunities to participate in local and national conferences where they can further enhance their instructional craft.

Despite these support systems, there are still issues with the current science education curriculum, namely regarding student diversity and equitable treatment. According to the Next Generation Science Standards (n.d.), "reports consistently highlight that, when provided with equitable learning opportunities, students from diverse backgrounds are capable of engaging in scientific practices and constructing meaning in both science classrooms and informal settings" (NGSS Appendix D, p. 1). What is science teaching doing to ensure student success?

Student diversity is ever growing in classrooms across the country. Specific measures are necessary to address students' educational needs (Ladson-Billings, 1992). Race, language, economic, and family situations can contribute to widening the gap for students to receive equal opportunities to achieve their educational goals (Gay & Kirkland, 2003). Closing the achievement gap would help reduce social inequalities and allow access to experiences and opportunities that promote a positive change in students' lives.

CSP can play a vital role in promoting student success in science by recognizing and valuing the diverse cultural backgrounds and experiences of students (Paris, 2012). CSP can create an inclusive and equitable classroom environment where all students feel valued and respected. Creating such an inclusive and supportive learning environment will foster student engagement, confidence, and success in science.

Curriculum Development for Inclusive Classrooms

Extensive efforts to improve K–12 science curriculum have taken place since the early 19th century (DeBoer, 1991). With the No Child Left Behind Act of 2001, the government took extensive strides at curriculum reform beginning with English and Mathematics (NCLB, 2002). In turn, the National Science Foundation was created to tackle the challenges of improving science education curriculum from grades K–12 (NSF, 2020).

The NGSS was established to ensure science educators developed learning standards with all types of students in mind (National Research Council, 2013). Student demographics were defined as students with diverse ethnic backgrounds, races, and socio-economic levels that reflected the diverse country we live in. Even with a diverse student demographic in mind, the educational achievement gap is still evident (California State Board of Education, 2019).

A way teachers can begin closing the gap is by meeting the individual needs of each and every student (Griner, 2011). Leveraging students' home-based and community learning styles by using those skill sets in our lessons can increase their academic success (Gonzalez et al., 2005. This creates a connection between home and school learning where students may see themselves represented in their curriculum and have their ethnic and cultural identities valued and affirmed (Lopez, 2014).

Ladson-Billings (2006) argued for a change in the way we perceive the achievement gap by renaming the term to educational gap. She argued that the term achievement gap places the blame on students being defective and lacking, and having the need to catch up with society because a set group of individuals are performing better. Rather, marginalized groups were systematically denied educational opportunities in four areas: slavery and post-emancipation, Jim Crow era, school segregation, and systemic racism and educational disparities (Cowan-Pitre,

2014). By changing the term to educational gap, we recognize there is more going on beyond test scores. It involves recognizing historical injustices, addressing present day disparities, and striving for equitable access to education. Policy initiatives, reparations debates, and efforts to promote equal educational opportunities are ongoing discussions that aim to redress these historical and ongoing injustices. Correcting the educational debt recognizes adequate access to resources, support, and opportunities will lead students to succeed. Changing the term to educational debt places accountability on society.

Our country's racial and ethnic diversity has dramatically increased since 2010 (U.S. Census Bureau, 2021). Peek into any classroom and you will notice 20% of the student population are of immigrant origin (Pew Research Center, 2013). About the same percentage of students also speak a language other than English at home (U.S. Census Bureau, 2015).

Students are bringing in a variety of backgrounds, languages, cultures, and perspectives into the classroom (National Center for Education Statistics, 2021). The United States is one of the most multicultural countries in existence, yet the curriculum taught in today's classrooms reflect "the voices of white men" (Howe & Lisi, 2014, p. 64). Enduring this Anglocentric voice in our educational system reinforces and perpetuates social inequalities that arise from differences in class, gender, race, and ethnicity (Hammond, 2015). Teaching in the perspective of "white men" excludes the value of classroom diversity.

Classroom studies of underserved students identified as students of color, English learners, and/or fall into the low socioeconomic status are underestimated (Hammond, 2015) in their educational capabilities. Because of these identifying labels placed on students, teachers might implement less than adequate instruction, often eliminating higher order skills

development entirely. Much of the intellectual abilities and other types of intelligences go unnoticed in ethnically diverse students (Gay, 2010).

The opportunity for culturally and linguistically diverse students to develop higher order thinking skills and "habits of mind" (Hammond, 2015, p. 13) are limited or lost because of this educational inequity. Habits of mind refers to a person's ability to think through a problem intellectually (Costa, 2021). Instead of perceiving multilingual students with diverse cultures as having a deficit in learning (Lombardi, 2016), teachers can utilize this information to build upon their funds of knowledge (Gonzalez et al., 2005).

Funds of knowledge refers to the idea of educators using specific family and cultural backgrounds and the lived experiences of their students to enhance their classroom community (Gonzalez et al., 2005; Moll et al., 1992). Teachers validate their students' values and personal beliefs when the identities of their students are upheld and incorporated into their classrooms. Developing a deep understanding of the household, community, and social conditions and classroom dynamics can also strengthen the relationships between teacher and parents as well.

Acknowledging diversity in the classroom allows students the opportunity to positively experience other cultures (Banks, 2019). Exposure to culturally diverse ways of thinking allows individuals to gain a greater self-understanding by viewing themselves from multiple perspectives of other cultures (Gay & Kirkland, 2003; Howe & Lisi, 2014). Experiences with diversity can lead to an appreciation and wanting to learn more about the diversity of cultural identities (Banks, 2019).

Multicultural Education

Representation matters. Integrating the identities and cultures of students into classroom content can help teachers close the achievement gap (Gay & Kirkland, 2003; Ladson-Billings,

1992). One of the most effective ways to improve student learning is to incorporate instruction that makes a personal connection to the students sitting in the classroom (Banks, 2019). A first step towards creating an all-inclusive classroom is using lessons that emphasize multicultural education.

Multicultural education is the process of accepting and appreciating the diversity of people and their cultures while incorporating the histories, texts, values, beliefs, and perspectives of people from different cultural backgrounds (Banks, 2019). It calls for teachers to "incorporate the idea that all students-regardless of their gender, sexual orientation, social class, and ethnic, racial, linguistic, or cultural characteristics-should have an equal opportunity to learn in school" (Banks, 2019, p. 1). Multicultural education is mainly a result of the increased number of people who are nonnative speakers, particularly English. The goal of multicultural education is to create equal opportunities for learning for those students who are marginalized because of social and economic inequalities.

Multicultural education's goal is student-centered, placing value on the histories and lived experiences of the diverse groups of students in the classroom (Banks, 2019). In recent work, Banks (2019) outlines four levels of varying approaches to multicultural reform in which educators can adopt accordingly into their classrooms and school communities. The four approaches are as follows: The Contributions Approach, Additive Approach, Transformation Approach, and the Social Action Approach.

The Contributions Approach reflects the minimum amount of involvement in multicultural education approaches where educators can focus on incorporating merely some of the heroes, celebrating special holidays and a few standout events (Banks, 2019). An example of

this is celebrating the legacy of Martin Luther King, Junior on the third Monday in January by taking the day off without necessarily addressing why schools are closed for the holiday.

In the Additive Approach, educators incorporate more variety of content, concepts, themes, and perspectives to the curriculum without changing its basic structure (Banks, 2019). An example of this would be incorporating Native American perspectives to teaching about Thanksgiving, but not changing the original point of view from the lesson.

In Banks's Transformation Approach (2019), the structure of the curriculum is changed to enable students to view concepts, issues, events, and themes from the perspectives of diverse ethnic and cultural groups. In the Social Action Approach students make decisions on important social issues and take actions to help solve them. Consider the Thanksgiving example again. The progression of lessons here would involve students using critical thinking skills to consider cultural conflicts of the diverse, multiple perspectives involved in the holiday.

Multicultural education is a great way for teachers to begin incorporating diversity by creating opportunities to reflect their students' cultures in their classrooms for positive social interactions to form. However, it does not consider the cognitive capacities of students (Hammond, 2015). Neglecting the cognitive learning capacities of diverse students further marginalizes students educationally (Paris, 2012).

Culturally Responsive Teaching

Culturally and linguistically diverse students often receive less rigorous instruction because teachers underestimate their abilities or believe they are incapable because of the labels they receive, such as English Language Learner (Hammond, 2015). Students with labels of "English Language Learner, poor, or students of color tend to receive instruction absent of requiring higher order thinking skills" (Hammond, 2015, p. 12). Lower skill sets are habitually

taught where the cognitive growth of these students becomes stunted due to frustrations and lack of academic support.

Incorporating the learning styles and meaning making of students from various cultures and responding positively with constructive feedback uses cultural knowledge as a scaffold for students to make connections to new material and concepts in a culturally responsive way (Gay, 2010; Hammond, 2015). Culturally responsive education is about building the learning capacity of the students (Hammond, 2015).

Culturally responsive education incorporates the "characteristics, personal experiences, and perspectives of culturally diverse students" (Gay, 2002, p. 106) in the classroom to make learning more meaningful. Effective teaching in this manner requires the teacher to not only be at mastery level in content and pedagogical skills, but also have an extensive knowledge base of their student population (Hammond, 2015). "Positive knowledge and perceptions of cultural diversity" (Gay, 2002, p. 182) is what drives culturally responsive education to foster a student-centered environment.

Teachers who practice culturally responsive teaching set rigorous learning intentions for all of their students while upholding their students' cultural identities (Gay & Kirkland, 2003). These teachers continuously foster relationships using culturally effective scaffolds between what students need to know and their culture, ethnicity, and lived experiences (Ladson-Billings, 2014). Culturally responsive teaching is about finding a balance between "rigor and relevance" (Muñiz, 2019, p. 6).

Culturally responsive teaching uses instructional strategies that mirror the cultural learning styles taught at home and within their communities by their parents, grandparents, and neighbors who have close relationships to their families (Gay, 2010). This validates students'

culture by acknowledging the importance of racial and cultural diversity in learning. Building this bridge between home and school experience acknowledges the legitimacy of the cultural heritages of different ethnic groups.

Culturally responsive teaching works synchronously with developing students' positive ethnic and cultural identities while achieving academic success (Ladson-Billings, 2014). A paramount strategy teachers can implement and achieve success is using home languages. Incorporating the use of students' home languages honors their ethnic identities and heritage languages (Gay, 2010).

Language is used as the primary way of knowledge transfer and meaning-making through oral and active communication (Gay, 2010). As human beings, our conversations are dynamic in they require us to be interactive to engage with other people. Language is more than the surface level of our spoken words. We reveal our ethnic, linguistic identities when we converse with people (Gay, 2010, p. 105).

There is a close relationship with a person's ethnic identity and their heritage or native language (Gay, 2010). Languages have a deep cultural connection where certain words can be used differently based on socialization. Languages can reveal biases, such as gender (Gay, 2010, p. 133) and implicit biases (Gay, 2010, p. 105) held by their cultural societies.

As a Korean woman, I have cultural and social norms in my heritage language I adhere to when addressing other people based on their age and gender. Out of respect for my Halmoni, meaning grandmother in Korean, I would not talk to her the same way I would to my younger cousins. This differentiation holds true in many other cultures that show an appreciation for their elders.

The difference between the Korean language and some other languages is we also have linguistic structures, called Honorifics, embedded into our speech. Korean Honorifics are linguistic expressions where specific words are coupled with phrases used to identify a person's age and gender to offer politeness and to reflect how they honor them within the Korean Culture (Seo, n.d.). Most cultures have ways of expressing respect for their elders. Koreans also set a gender hierarchy by which they use more respectful and culturally polite phrases when speaking to males over females. Acknowledging Korean linguistic expressions in the classroom promotes social inclusivity and acceptance of another culture.

There is a relationship between a person's race, racism, and language (Paris & Alim, 2017). Linguistic racism can be perceived by individuals who identify their ethnicity with their native language (Gay, 2010). This occurs when prejudices are made against people for how they speak their native language or express their culture.

Cultural assumptions of individuals are made based on their frames of reference and perspectives (Banks, 2019). Holding cultural assumptions can translate into implicit biases when we have attitudes towards people because of stereotypes we associate with them regardless of unconsciously knowing (Collins, 2019). These assumptions we hold can influence how we treat and view people.

Implicit bias can be seen in the classroom as teachers holding lower expectations for students who fall into categories of English language learners, low socioeconomic status, and students of color (Gay, 2010). Sex and gender biases are not mutually exclusive from implicit bias either (Bank, 2019; Collins, 2019). Teachers use less rigorous instruction assuming students are incapable of comprehending at higher levels because of their perceived lower expectations of

those students' academic performance (Hammond, 2015). These factors can negatively impact student achievement, decreasing their overall academic scores (Gay, 2010).

Linguistic profiling (Chin, 2010) of students of color is an example of implicit bias (Paris & Alim, 2017). The linguistic practices of students not using standardized English or speaking with an accent are often misheard and devalued regardless of the meaning of their words corresponding to the correct standardized academic language (Chin, 2010; Paris & Alim, 2017). Linguistic profiling and accent bias set limitations and deny educational opportunities to students of color (Chin, 2010; Hammond, 2015; Howe & Lisi, 2014).

When teachers make assertions over correct pronunciation and better word choices that align more with standardized English over African American Vernacular English, Appalachian English, or Chicano English, they are perpetuating the notion that one language and culture is better than the others (Howe & Lisi, 2014). Students of color are further marginalized by feelings of anxiety and inferiority because of the negative attitudes from their teachers reflected upon them (Paris & Alim, 2017). This can leave students feeling inadequate about their intellectual abilities (Harmon, 2021).

"A vital ingredient for student success is having your teacher believe in you" (Marco Learning, 2018, para. 10). When students do not feel this connection, their self-efficacy can diminish resulting in slowing their academic progress and affecting their performance attainments (Gay & Kirkland, 2003; Howe & Lisi, 2014). Teachers can lessen the probability of this occurring by incorporating the learning styles from various cultures of their students into their teaching pedagogy (Gay, 2010). It is important to recognize learning styles can vary across individuals within any cultural group, and generalizations should be made with caution. However, cultural backgrounds and experiences can influence learning preferences and

approaches to education to some extent. Students' learning preferences are influenced by a combination of cultural, personal, and environmental factors. Recognizing and respecting these variations can help teachers create inclusive and culturally sustaining learning environments that cater to a diverse range of learners.

Culturally responsive teachers respond positively and constructively by using their cultural knowledge of their students and incorporating their learning styles into their teaching (Gay, 2002; Gay, 2010; Gonzalez et al., 2005; Hammond, 2015). Employing strategies using cultural characteristics and experiences of your culturally diverse students is what it takes to be a culturally responsive teacher (Gay, 2002; Hammond, 2015).

Yet cultural responsiveness alone may not be sufficient to address the systemic inequities and challenges faced by marginalized students (Hammond, 2015). CSP (Paris, 2012) builds upon the principles of culturally responsive pedagogy and takes it a step further by focusing on sustaining and revitalizing students' cultural identities and knowledge within the educational context.

Promises of Culturally Sustaining Pedagogy

Providing different pathways for students to learn gives students opportunities to meet expectations as a multicultural educator (Gay, 2010). Bringing in the experiences and cultures of students opens the door for student-centered learning to occur in culturally relevant teaching (Hammond, 2015). Encouraging students to use their cultural practices from home in school and maintaining them affirms CSP (Paris, 2012).

Creating opportunities where students can feel a sense of belonging and a space where they feel safe, respected, and heard are attributes of effective teaching (Cook-Sather et al., 2009; Hammond, 2015). Improving the learning capacity of diverse students by focusing on the

cultural assets (Gonzalez et al., 2005) students bring into the classroom turns the attention positively towards what students can do rather than focusing on what they cannot do or their weaknesses (Gay, 2010; Hammond, 2015). A way we can accommodate student learning is by inviting students to use their primary languages in the classroom (Paris, 2012; Paris & Alim, 2017).

Allowing students to use their primary language in the classroom fosters the value and appreciation of cultural awareness of our "multiethnic and multilingual society" (Paris, 2012, p. 93). The inclusion of primary languages sustains the language and literacy skills taught at home (Ladson-Billings, 2014). This encourages active participation and facilitates learning for all students (Ladson-Billings, 2014; Paris & Alim, 2017).

Another way to create an all-inclusive classroom is to invite students and teachers to use each other's preferred pronouns (Baum & Westheimer, 1991–2021). Only using the binary forms of male and female genders excludes people who do not narrowly fit into those two categories. Acknowledging and using people's preferred pronouns supports students who identify with non-binary, gender non-conforming, and/or transgender (Harbin, 2016).

Anti-bias education involves teaching students to understand, accept, and value the differences of people (Anti-Defamation League, 2021). It calls for people to challenge bias and stereotyping, and all forms of stereotyping in communities. There are four goals anti-bias education aims to teach, creating a space where students can feel safe and supported by their community (Derman-Sparks & Olsen-Edwards, 2019). The four goals are identity, diversity, justice, and activism.

The goal of Identity is to guide students in exploring their personal and social identities so they learn self-awareness, building confidence and pride for their families (Derman-Sparks &

Olsen-Edwards, 2019). Students make connections of who they are as individuals and as members of a cultural group. Nurturing students to feel positive about themselves, but not superior or inferior to other groups is key.

Diversity's goal is to promote empathy for others by increasing the comfort levels students have with people of different cultures than theirs (Derman-Sparks & Olsen-Edwards, 2019). Promoting empathy with diversity involves developing an awareness of diverse groups of people. This includes encouraging students to behave respectfully and kindly in every interaction they have with other people who have different cultural or racial backgrounds (Derman-Sparks et al., 2020).

The goal for justice is to teach students how to recognize unfairness and have the language to describe how it may feel to experience it (Derman-Sparks et al., 2020). This involves helping students develop a knowledge base and strengthening their analytical skills to identify unfair treatment, stereotypes, negative comments, and discrimination (Derman-Sparks et al., 2020; Ladson-Billings, 1995, as cited in Paris & Alim, 2017, p. 17). The overall goal is to build a sense of safety in that everyone can and will be treated fairly.

The goal of activism is to instill a sense of empowerment and the courage and skills set to act on them (Derman-Sparks et al., 2020). Teachers help cultivate students' ability to recognize and stand up against prejudice and discriminatory acts they experience or witness (Banks, 2019). This means practicing with students a variety of ways of standing up to adversity individually or with a group. This goal strengthens students' ability to look at a situation from a viewpoint different from their own (Howe & Lisi, 2014), critique social situations and inequalities, and demonstrate conflict resolution skills to support fair treatment for everyone (Ladson-Billings,

2014). This call to action creates an equitable environment for all (Derman-Sparks & Olsen-Edwards, 2019).

Culturally sustaining leadership and advocacy calls for educators to be knowledgeable about diversity, have the skills to utilize that knowledge, and the ability to use those skills to make changes within their communities by supporting diversity through leadership actions (Banks, 2019; Hammond, 2015). Culturally sustaining leadership is necessary in all settings to develop and promote a welcoming climate for everyone to feel inclusive and is accepting of all individuals regardless of race, social class, linguistic or cultural characteristics, gender, or sexual orientation (Banks, 2019).

Culturally sustaining leaders promote opportunities where all members of the community not only use their cultural practices from home, but maintain them (Ladson-Billings, 2014). In an educational setting, this bridges the culture of home to school so students can exist fully and symbiotically in both environments (Hammond, 2015). The best way to exercise leadership and advocacy for culturally sustaining education is to utilize the funds of knowledge (Gonzalez et al., 2005) of your community to inform next steps in creating opportunities for equitable actions to take place.

The first step towards cultivating culturally sustaining practices in an educational setting is to get to know your students (Cook-Sather et al., 2009) and evaluate your instructional practices to determine if they are meeting the needs of your students (Gay, 2010; Hammond, 2015). This can be done with surveys sent home to families to better understand their culture, knowledge, and experiences students are bringing into the classroom to inform your educational practices.

Culturally sustaining practices and advocacy is a “commitment of promoting a culture of respect and inclusion” (Anti-Defamation League, 2021, para. 7). Actions to empower staff, students, and community members can be utilized through professional development, student leadership opportunities and training to be allies, educational forums and community events focusing on anti-bias education, social and emotional learning, and bullying prevention (Anti-Defamation League, 2021).

Teachers can develop lessons that address the impact of social stereotypes, biases, and discrimination by creating opportunities for students to practice these concepts of diversity in a positive manner. Student practice through discussions (Gay & Kirkland, 2003) and role play scenarios (Cook-Sather et al., 2009) empowers the individual by giving them the necessary tools to foster confidence in social settings and be able to display empathetic interactions, critical thinking skills, and activism (Ladson-Billings, 2014; Paris, 2012).

CSP is more than just creating a sense of belonging so everyone can feel included. Advocacy is about being proactive through social activism to make changes in the structural design of institutions, so it reflects culturally sustaining practices (Howe & Lisi, 2014). Evidence of this can be seen by how a community responds to a diverse group of people and the social message people receive.

If the perception felt by individuals is that they are racially or culturally inferior or just not normal based on attitudes and behaviors perpetuated by the dominating social and cultural class (Paris, 2012), then we have failed as a society. We need to improve our efforts of developing a positive self-concept in our students without absorbing any negative social messages they may endure (Cook-Sather et al., 2009; Hammond, 2015). This is a challenging feat but necessary if we truly want to achieve social harmony.

CSP reframes how educators think about and teach students, especially those typically marginalized by society (Ladson-Billings, 1992). Acknowledging the cultural richness and the diversity students bring into the science classroom as assets rather than problems that need to be fixed, can empower students intellectually, socially, and emotionally by using cultural references to impart knowledge, skills, and attitudes to enhance their science education. Educators who adopt CSP become transformative change agents that can potentially reverse the cycle of inequity in our educational system.

In my methodology section, I will explore CSP's transformative potential for the teaching and learning that takes place in multicultural science classrooms. The expectation is CSP will help culturally and linguistically diverse students develop and sustain cultural competence and academic success (Paris & Alim, 2017).

Using CSP in our curriculum development can help to create a more inclusive and supportive learning environment for diverse learners. It means being aware that students learn in different ways, so it is important to use a variety of teaching methods to accommodate different learning styles by identifying and providing any accommodations they may need. Implementation of CSP can create a welcoming and inclusive learning environment that supports the success of all students, regardless of their background or learning style.

Sheltered Instruction in Science

Sheltered instruction in science is an approach to teaching science designed to support the learning of English language learners (ELLs) who are in the process of acquiring English proficiency (Settlage et al., 2005). This approach incorporates instructional strategies and techniques that make science content more accessible to students who are still developing their English language skills. Sheltered instruction involves the use of visual aids, such as diagrams

and illustrations, along with foldables and graphic organizers that allow students to review the content being covered in class. These visual representations of words and concepts are used as scaffolding tools and strategies for students to be successful in the classroom (Stoller, 2002).

Sheltered science literacy, modeled after sheltered instruction (CATESOL, 1992), is an approach to teaching science designed to support the learning of students who are in the process of acquiring English proficiency (Short et al., 2011). The approach incorporates instructional strategies and techniques that make science content more accessible to students who are still developing their English literacy language skills. The goal of sheltered instruction in science is to create a learning environment inclusive and supportive of all students, regardless of their language background or proficiency.

By making science content more accessible to ELLs, all students can build their science knowledge and skills while also developing their English proficiency. While sheltered instruction focuses primarily on language acquisition and content access for students developing their language skills (Short et al., 2011), CSP (Paris, 2012) takes a broader perspective, emphasizing cultural affirmation, community engagement, and social justice. Both approaches can be complementary and implemented together to meet the diverse needs of students in culturally and linguistically diverse classrooms.

Coupling CSP with science literacy, the curriculum for a sheltered science literacy elective class was designed in this study to make science literacy more accessible for students who may struggle with language barriers, and to help them develop the skills they need to become more proficient with science. The use of sheltered instruction in science can help below grade level readers access content and comprehend concepts by engaging in hands-on activities.

This approach values and builds on the linguistic and cultural diversity of students, while also promoting their academic success.

CSP in science literacy involves integrating cultural and linguistic diversity into science education to create a more equitable and inclusive learning environment (Paris, 2012). In the next section, I will discuss how the Transformative Paradigm was paired with CSP to frame my methodology. Transformative paradigm and culturally sustaining pedagogy are two approaches to education that share a commitment to equity, inclusion, and social justice. They can be used together to create transformative and culturally sustaining environments.

CHAPTER III: METHODOLOGY

The Transformative Paradigm provided the framework for my curriculum development as it addresses the inequalities and cultural injustices marginalized students face in society (Mertens, 2009). CSP (Paris, 2012) and Backward Design (Wiggins & McTighe, 2005) guided the curriculum development of a science literacy elective class for below grade level readers. The California Department of Education's CSP (2023) guidelines outlining CSP's features and what it looks like in a classroom will be proposed as an assessment tool to evaluate the curriculum after implementation. The project-based learning approach offers insight to students' understanding and ability to demonstrate their knowledge in culturally sustaining ways.

The curriculum was designed with entrance criteria based on students' performance scores on the Renaissance Standardized Testing and Reporting (STAR) assessment (Renaissance Learning, 2022). The STAR assessment is used to measure a student's reading ability, phonological awareness, and early numeracy skills. The assessment is administered electronically using a laptop and is given during their English Language Arts class. The data is collected by the school district using the Renaissance Learning testing platform and reported back to the schools. The assessment is given at the beginning, middle, and end of the school year. Students who enter the science literacy elective class would have tested below the 10th percentile of their grade level for reading at the beginning of the school year, which is equivalent to the urgent intervention category of their STAR assessment. Offering the elective class to below grade level readers is a way to provide an alternative curriculum that is more accessible and meaningful to students who struggle with traditional academic content.

Research Paradigm

The Transformative paradigm guides the framework of the curriculum development for addressing the inequalities and unjust social constructs in relation to education and pursuit of social justice (Mertens, 2009). Its framework centers the experiences of marginalized groups, such as women, ethnic and racial minorities within a community, people with disabilities, and those who are poor, and links research findings to actions intended to mitigate disparities. The Transformative paradigm comprises four philosophical assumptions: axiology, ontology, epistemology, and methodological assumptions (Mertens, 2017).

The axiology for Transformative paradigm places emphasis on the respect for cultural norms to support human rights and social justice in the classroom (Mertens, 2009). This assertion calls upon the researcher to act in ways that are respectful to the diversity of all cultural groups (Paris & Alim, 2017) involved in the study. Using a transformative lens, CSP refers to an approach to education that seeks to promote and maintain the cultural and linguistic diversity of students while also challenging and transforming the systemic oppression that can exist within educational institutions. This understanding provides the basis for using the transformative research design as the evaluative process to identify and address inequities in order to support human rights to further social change within the science curriculum.

The ontological assumption of Transformative paradigm adopts the idea that social reality is shaped by multiple realities by social, political, cultural, economic, race ethnic, gender and disability values (Mertens, 2009). These realities collectively inform the conscious experience of individuals and groups within a community. Change in understanding can be documented by checking in with individuals and group members of the community. CSP recognizes students' cultural identities and experiences as assets used to enhance their learning

and engagement in school. This approach emphasizes the importance of validating and affirming students' cultures, languages, and lived experiences in the classroom, rather than suppressing or assimilating them into dominant cultural norms.

A Transformative paradigm involves critically examining and challenging the underlying power structures and inequities that exist in society, including those perpetuated by educational institutions. This paradigm emphasizes the need for systemic change and social justice, with a focus on creating more equitable and just educational environments. The epistemological assumption is the curriculum will be transformative by making students co-producers of their knowledge with goal setting and reflective thinking (Mertens, 2009). Critical thinking skills, collaboration among students, and epitomizing student-teacher relationships will make this possible.

By using a transformative lens, the methodological intent is to create change for an improvement in the students' educational interests through curriculum development for a science literacy elective class. The hope is to gain deeper insight into the multiple factors that influence the development of student values to provide equitable opportunities for reaching their full academic potential.

Combining culturally sustaining pedagogy with a Transformative paradigm involves creating educational spaces that not only affirm students' cultural identities and experiences but also challenge and transform the underlying power structures and systems of oppression that can exist within educational institutions. This can involve promoting critical thinking, social justice, and activism in the classroom, as well as working to dismantle systemic barriers and inequities with educational institutions and society as a whole.

The next section will discuss how culturally sustaining pedagogy was used as an approach to curriculum design. This approach to education recognizes and values the diverse cultures and experiences of students. It goes beyond the concept of multicultural education (Banks, 2019), which often focuses on just acknowledging and appreciating different cultures, to actively centering and sustaining students' cultural identities and practices within the learning environment (Paris, 2012). The goal of culturally sustaining curriculum design is to create inclusive and empowering educational experiences that promote equity, social justice, and academic success for all students.

Approach to Curriculum Design

The method involved developing a curriculum for an elective class focusing on science literacy, or an understanding of scientific vocabulary/concepts. The objective of the curriculum was to design a sheltered (U.S. Department of Education, 2020) science elective class for students who read below grade level. The use of CSP (Paris, 2012) in creating the sheltered science elective class, *STEAM for All*, was intended to provide universal access and equitable opportunities for all learning levels in the instruction of Science, Technology, Engineering, Art, and Mathematics (STEAM).

Science literacy (National Science Teachers Association, 2014) requires an extensive understanding of scientific vocabulary. Without a strong scientific vocabulary, it is difficult to understand and communicate scientific concepts. In science, fluency is important because scientific texts often contain complex sentence structures and technical terms that can be challenging to read and understand.

A sheltered science literacy class can be described by borrowing the definition of a sheltered curriculum. A sheltered curriculum is a way to integrate the development of the

English language and the teaching of content for students who are English language learners (Echevarria et al., 2016). The rationale behind using a sheltered curriculum is to address the needs of the students who make up the majority of the student population, being mostly multilingual learners.

A sheltered science literacy curriculum design was selected as a teaching strategy to support students who struggle with reading comprehension due to limited English proficiency or language barriers (CATESOL, 1992). The goal of the curriculum design was to provide these students with materials appropriate for their language level and to provide scaffolding strategies to help understand the material more effectively.

The sheltered science literacy curriculum design provides students with simplified texts, such as books or articles, which have been modified to include more basic vocabulary and sentence structures (Teacher Created Materials, 2023). Teachers may also use graphic organizers, such as charts or diagrams, as scaffolding strategies to help students visualize the information in the text. In addition to modifying the materials, teachers may also provide explicit instruction on literacy strategies, such as how to use context clues to determine the meaning of unfamiliar words, or how to identify the main idea of a passage.

The Backward Design model (Wiggins & McTighe, 2005) is a planning process that involves starting with the desired learning outcomes and then working backward to determine the appropriate instructional strategies and assessment methods. This process was used in the creation of the science literacy lesson plans. By using the Backward Design model for science literacy, educators can ensure their instruction is aligned with the desired learning outcomes and students are given the best opportunities to develop their scientific literacy skills.

In science literacy, comprehension requires understanding the scientific concepts and principles presented in the text (National Science Teachers Association, 2014). Scientific texts often require the reader to use critical thinking and reasoning skills to make connections between different concepts and ideas. This skill is essential for making informed decisions and drawing conclusions based on scientific evidence.

Science involves inquiry, where students are asking questions, investigating and exploring scientific phenomena, and using evidence to support claims (Next Generation Science Standards, 2012). This skill is essential for developing a deep understanding of scientific concepts and engaging in scientific inquiry. Project-based learning approach (PBL; Krajcik et al., 2014) has the potential to help students develop a deeper understanding of scientific concepts and their relevance to real-world issues.

Project-based learning approach (PBL; Krajcik et al., 2014) allows teachers to provide students with resources to help them research and analyze the problem at hand. Resources could include scientific articles, videos, and other relevant sources. PBL encourages students to work collaboratively to identify potential solutions to the problem. Instructional strategies could involve brainstorming, conducting experiments, or analyzing data. This results in helping students evaluate the strengths and weaknesses of their proposed solutions and encourages them to revise and refine their ideas. CSP (Paris, 2012) can inform and enhance a PBL approach by incorporating students' cultural backgrounds, experiences, and knowledge into the project design and implementation. This approach helps students see the connections between their cultural backgrounds and the content they are learning, fostering a sense of belonging, pride, and academic achievement.

Student Enrollment

I hope to implement the *STEAM for All* curriculum in the 2023–24 school year. Upon implementation of the curriculum, students will be given the option to participate in the sheltered science literacy elective class on a voluntary basis. Students will have an opportunity to enter the program at the beginning of the school year. The elective class is designed to run for only one semester, consisting of 18 weeks of school. Students may request a schedule change with the school's administration if they no longer wish to participate in the class.

Situated in the San Joaquin Valley in central California, the junior high school consists of grades 7 and 8. The demographics of the student population of the junior high school consist of Hispanic (85.6%), African American (6.6%), White 5.4%), two or more races (1.1%), American Indian (0.8%), and Asian (0.6%) students (National Center for Education Statistics, 2022). Students are between the ages of 12 and 13 years old. The junior high school has Title 1 status meaning the school qualifies for federal funding under the Every Student Succeeds Act (ESSA) to help students who are behind academically, or at risk of falling behind due to low socio-economic status and/or hardship (California Department of Education, 2017).

Evaluating the Curriculum's Effectiveness

The use of California Department of Education's descriptions (2023) for effective use of CSP in a classroom was used to design an evaluation of the curriculum's effectiveness, as discussed in Chapter V. Project-based learning approach (PBL; Krajcik et al., 2014) will be used in the design to measure students' understanding and ability to demonstrate their knowledge in culturally sustaining ways.

PBL (Krajcik et al., 2014) in science literacy is essential for developing a strong foundation in science and for understanding the scientific world around us. The approach

involves presenting students with a complex, real-world problem and challenging them to solve it by applying their knowledge and skills. Using PBL as an instructional tool can be effective in promoting critical thinking, problem-solving, and collaboration skills.

CHAPTER IV: *STEAM FOR ALL* CURRICULUM

STEAM for All is a one semester inquiry-oriented and literacy focused science elective course for 7th graders who read below grade level. This course explores the relationships between natural processes and human activities that cause energy to flow and matter to cycle through Earth's systems. Students will develop conceptual understanding and skills related to science with opportunities to engage in science literacy by using the project-based learning (PBL) approach (Krajcik et al., 2014).

The end goal of this class is to have students engage with science content material in a meaningful way through the activities provided with PBL and improve their science literacy skills using Teacher Created Materials Publishing: Exploring Science reading curriculum (Teacher Created Materials, 2023) and Benchmark Assessment System's (BAS; Fountas & Pinnell, 2022) leveled science books. Student learning outcomes will be assessed using evidence and reasoning based on personal life and local (geographical) experiences expressed through PBL activities.

Intentional Language

Educators can use the multidimensionality of their personhood (Berry, 2010) with the use of culturally sustaining pedagogy to dismantle the dominant social constructs and discourse perpetuated within school communities. Creative discourse using intentional language is instrumental in implementing this strategy through personal narratives. Educators implementing such an approach will effectively promote social inclusion that helps connect and unite diverse students.

Creative discourse is a method in which educators can implement this strategy using narrative storytelling. Narrative storytelling (Berry, 2010) allows educators to center the

conversation for those who are socially and politically marginalized by the dominant culture. The inclusion of narrative storytelling allows for students who are identified as members of the socially marginalized group to dismantle the dominant narrative to create shared realities more inclusive to all individuals.

Creative discourse (Berry, 2010) is an essential component of PBL (Krajcik et al., 2014). It involves engaging students in meaningful and open-ended discussions that encourage them to explore new ideas, share perspectives, and consider alternative approaches to problem-solving. Teachers can create a learning environment that fosters and supports students in developing critical thinking, collaboration, and communication skills.

Being intentional with our language is an instrumental component in creating opportunities for promoting social inclusion that help connect and unite diverse students. Being proactive in using specific language that honors and accepts the identities of our students empowers students' voices. Intentional language offers students an opportunity to be seen, understood, accepted, and valued in their school communities. By combining creative discourse with intentional language, teachers can create a learning environment that promotes cultural competency, mutual respect, and collaboration. This can help prepare students for success in diverse communities.

Meeting the Needs of Diverse Learners

To meet the needs of multilingual students in the classroom, lessons will be translated from English into Spanish and Arabic daily. Bing and Microsoft Translator are used during direct instruction and for students who use their native language. Immersive Reader and Google Translate are used for digital and print materials. Picture examples of vocabulary and science

models are used whenever possible. Students are encouraged to use their native language when speaking in class.

The individual learning plans for students with special needs will be incorporated and addressed by using various teaching modalities used for daily instruction. A variety of presentations will be used for repetition, such as Generation Genius and Bill Nye videos along with BrainPOP and Study Jams to offer visual displays of the content. Students will also be allowed flexibility in submitting assignments for assessments. Oral presentations, building and/or sketching models, working in flexible groups will meet these needs.

A sheltered science literacy approach (CATESOL, 1992) will be used in designing the lesson plans. This approach will provide students with the language support they need to access and understand the content using visual aids and simplified language and reading material leveled at their reading ability. Science is a hands-on subject that requires students to actively engage in experiments and investigations. Sheltered science literacy will provide ELLs and students with language barriers with the language skills they need to participate fully in these activities.

Project-based learning allows students flexibility and freedom for students to expand upon their strengths and deepen their learning based on their individual learning styles (Krajcik et al., 2014). It allows for student voice and choice to resonate so the lesson is differentiated to meet every student's needs. Students gain knowledge and skills by working on a project that engages them in solving a real-world problem or answering a complex question. This approach involves students in investigating, researching, and creating a product or a solution to a problem through a collaborative process.

In project-based learning, students are given autonomy and ownership over their learning experience, and they work in small groups or individually to plan, design, and execute their project (Krajcik et al., 2014). The teacher serves as a facilitator and a guide, providing support, feedback, and resources to help students achieve their goals. Project-based learning promotes critical thinking, problem-solving, collaborations, creativity, and communications skills, as students are required to work together, make decisions, and present their findings to an audience. It can enhance students' motivation and engagement as they are actively involved in a meaningful and relevant learning experience.

The following table describes the alignment between the instructional segment books used in the curriculum (see Appendix C), the targeted California state science standard addressed in each book (see Appendix D), and the Lexile reading level of the text. The instructional segment books are educational materials specifically designed to support science learning. They come in the format of science readers aimed to present scientific concepts and information in a way accessible to students at specific Lexile reading levels, or grade level equivalency (Teacher Created Materials, 2023). The science readers incorporate visual aids, simplified language, and contextual examples to enhance understanding. Each science reader aligns with state science standards to ensure the content covered in the materials corresponds to the required learning outcomes.

Aims, Goals, Objectives of Project

The aim of this curriculum development is to create a science curriculum that reflects the diversity we see in our classrooms. The goal is to provide students with opportunities to make personal connections with the content standards they are learning in science. The overall objective is for students to see similarities with their own lived experiences and how they can

relate those experiences to the science content they are learning in class while improving their science literacy skills. Students will draw personal connections to science content and be in control of their learning process using problem-based learning (PBL; Krajcik et al., 2014) methodology. Lessons using PBL methodology are designed to offer students opportunities to propose solutions that can directly impact their lives. PBL lessons will guide student-centered learning towards constructing their identities and foster a sense of belonging and acceptance in their school community.

The following is the curriculum outline of the science readers (see Appendix C) used in the lessons. Each description contains the science standard (see Appendix D) and its reading Lexile level for all science readers. The assessment and semester overviews describe how CSP (Paris, 2012) and Backward Design Model (Wiggins & McTighe, 2005) were used to develop the lessons in the curriculum. The semester's lessons are broken down by quarters, then by weeks. The weekly lessons contain the science topic and science readers used for that duration. Each quarter ends with a PBL (Krajcik et al., 2014) lesson as the culminating project for the quarter.

Curriculum: Exploring Science: Content and Literacy in Science

Quarter 1:

Instructional Segment	**Standard**	**Reading Lexile Level**
Car Crashes	PS3–1. Use evidence to construct an explanation relating the speed of an object to the energy of that object. PS3–3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.	760L – 770L

Instructional Segment	Standard	Reading Lexile Level
Renewable Energy	ESS3–1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. PS3–2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. PS3–4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.	600L – 750L
Sculpting Landscapes	ESS1–1. Identify evidence from patterns in rock formations and fossils in rock formations and fossils in rock layers for changes in a landscape over time to support an explanation for changes in a landscape over time. ESS2–1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. ESS2–2. Analyze and interpret data from maps to describe patterns of Earth's features. ESS3–2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.	680L – 750L

Instructional Segment	Standard	Reading Lexile Level
Earthquake Engineering	ESS2–2. Analyze and interpret data from maps to describe patterns of Earth's features. ESS3–2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. PS4–1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.	680L
Animal Senses	LS1–1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. LS1–2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.	700L – 780L
What is Matter Made of?	PS1–1. Develop a model to describe that matter is made of particles too small to be seen. PS1–2. Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.	720L – 810L

Instructional Segment	Standard	Reading Lexile Level
	PS1–3. Make observations and measurements to identify materials based on their properties. PS1–4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.	
From Matter to Organisms	LS1–1. Support an argument that plants get the materials they need for growth chiefly from air and water. LS2–1. Develop a model to describe the movement of matter among plants, animals decomposers, and the environment. PS3–1. Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.	750L – 830L

Quarter 2:

Instructional Segment	Standard	Reading Level
Interacting Earth Systems	ESS2–1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. ESS2–2. Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide	670L – 780L

Instructional Segment	Standard	Reading Level
	evidence about the distribution of water on Earth. ESS3–1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.	
Patterns in the Night Sky	ESS1–1. Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distance from Earth. ESS1–2. Represent data in graphical displays to reveal patterns of daily changes in the length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. PS2–1. Support an argument that the gravitational force exerted by Earth on objects is directed down.	730L – 860L
Systems and Subsystems in Earth and Life Science	MS–LS1–1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. MS–LS1–2. Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. MS–LS1–3. Use arguments	580L – 770L

Instructional Segment	Standard	Reading Level
	supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. MS–LS1–8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.	
Earth Systems Interactions Cause Weather	MS–ESS2–4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. MS–ESS2–6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. MS–PS3–4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.	690L – 750L
Causes and Effects on Regional Climates	MS–ESS2–5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.	570L – 820L

Instructional Segment	Standard	Reading Level
	MS–LS1–4. Use arguments based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. MS–LS1–5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. MS–LS1–8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. MS–LS3–2. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.	
Effects of Global Warming on Living Systems	MS–ESS3–3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. MS–ESS3–5. Ask questions to clarify evidence of the	810L

Instructional Segment	Standard	Reading Level
	factors that have caused the rise in global temperatures over the past century. MS–ETS1–1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.	

Application

Implementation of narrative storytelling using intentional language methods will be incorporated into lessons created using the Teacher Created Materials Publishing: Exploring Science reading curriculum (Teacher Created Materials, 2023) that are aligned to the Next Generation Science Standards (NGSS). Student learning outcomes will reflect an understanding of the content strands using evidence and reasoning based on personal life and local (geographical) experiences.

Approaches

Within the overall curriculum described above, the Backward Design model will guide the lesson planning process. Teacher Created Materials Publishing's Exploring Science Literacy (Teacher Created Materials, 2023) and Fountas & Pinnell Leveled Literacy (Fountas & Pinnell, 2022) program materials will be used for lesson planning to create evidence-based activities focused on science literacy.

Formative assignments will be incorporated into culminating summative projects in the form of PBL activities for each quarter. Projects will be graded based on each student's individual contributions, academic proficiency of standard as evidenced by the final product, and participation working within a group setting. Participation grading will be reflected in each student's citizenship grade aligned with the school's campus culture of assigning citizenship grades quarterly. Lessons will have connections to the overarching science standards focus for that quarter.

Lesson Planning Overview

Lesson planning for science content is based on the 5E model, a constructivist model implementing a student-led inquiry-based learning approach to science (NSTA, 2014). The 5Es consist of five phases where students engage, explore, explain, elaborate, and evaluate each focused science standard. Using the 5E model engages students' curiosity by encouraging them to ask questions while using evidence-based explanations to justify their reasoning. Implementing the 5E model as an instructional tool provides structure to content for students to make connections with the science ideas they are learning and apply their acquired knowledge to new contexts.

Lesson planning for content literacy is based on the five pillars of reading (National Reading Panel, 2000), which include: phonemic awareness, phonics, fluency, vocabulary, and comprehension strategies. Students will read guided reading level materials based on their reading scores taken from their BAS tests (Fountas & Pinnell, 2022). Students will be given vocabulary, leveled text dependent questions, and writing prompts to complete for each reading segment.

To ensure every lesson incorporates the diverse cultural perspectives and fosters inclusivity in science learning, each lesson will use the *Culturally Sustaining Lesson Plan Template* (see Appendix A) and the *Culturally Sustaining Lesson Plan's Essential Questions* (see Appendix B) in the planning process. Using these tools is imperative to promoting equity, inclusion, and academic success for all students. They help ensure that the CSP tenants are being met.

The difference between a traditional lesson plan and a CSP (Paris, 2012; Paris & Alim, 2017) lesson plan lies in their goals, approaches, and considerations for students' cultural identities and backgrounds. The *Culturally Sustaining Lesson Plan Template* (see Appendix A) goes beyond the traditional approach by actively valuing and integrating students' cultural identities, experiences, and perspectives into the curriculum. It takes a student-centered approach, promotes cultural relevance and social justice, and fosters inclusive and empowering learning environments. Here are some key distinctions:

1. Goals and Outcomes:
    - Traditional Lesson Plan: A traditional lesson plan primarily focuses on delivering content and meeting academic objectives defined by standards or curriculum guidelines.
    - CSP Lesson Plan: A CSP lesson plan aims to promote cultural relevance, inclusivity, and social justice in addition to meeting academic goals. It recognizes and values students' cultural identities, experiences, and perspectives as essential components of the learning process.

2. Student-Centered Approach:
    - Traditional Lesson Plan: A traditional lesson plan often follows a teacher-centered approach, where the teacher delivers information, and students passively receive it.
    - CSP Lesson Plan: A CSP lesson plan takes a student-centered approach, valuing students' prior knowledge, experiences, and cultural backgrounds. It actively engages students in the learning process, encourages critical thinking, and incorporates their perspectives and voices.
3. Cultural Considerations:
    - Traditional Lesson Plan: A traditional lesson plan may not explicitly consider the cultural identities and backgrounds of students. It often assumes a homogenous student population and may overlook the diverse cultural experiences that students bring to the classroom.
    - CSP Lesson Plan: A CSP lesson plan acknowledges and integrates students' cultural identities, backgrounds, and experiences into the curriculum. It incorporates diverse perspectives, histories, and voices, providing opportunities for students to explore, share, and critically analyze their own and others' cultures.
4. Instructional Materials and Resources:
    - Traditional Lesson Plan: A traditional lesson plan typically relies on standard instructional materials that may not reflect the diversity of students' cultural backgrounds or experiences.

- CSP Lesson Plan: A CSP lesson plan seeks out and uses instructional materials and resources that are culturally responsive, sustaining, and reflective of students' diverse cultures. It incorporates authentic resources, diverse literature, multimedia, and community-based knowledge to connect with students' live realities.

5. Assessment Practices:
    - Traditional Lesson Plan: Traditional lesson plan may rely on standardized assessments that may not consider students' cultural backgrounds, contexts, or diverse ways of demonstrating learning.
    - CSP Lesson Plan: A CSP lesson plan incorporates diverse and authentic assessment strategies that align with students' cultural backgrounds and experiences. It provides multiple ways for students to demonstrate their understanding, including through culturally sustaining projects, performances, presentations, or portfolios.
6. Community and Family Engagement:
    - Traditional Lesson Plan: A traditional lesson plan may not actively involve families or community members in the learning process, limiting the connection between students' cultural backgrounds and their education.
    - CSP Lesson Plan: A CSP lesson plan emphasizes the importance of community and family engagement. It actively seeks ways to involve families and community members, tapping into their cultural knowledge, traditions, and resources to enrich the learning experience (Paris, 2012; Paris & Alim, 2017).

Using the *Culturally Sustaining Lesson Plan Template* (see Appendix A) benefits students by affirming their cultural identities, promoting engagement, and enhancing academic achievement (Paris & Alim, 2017). It also supports the teacher in fostering an inclusive classroom, cultivating cultural competence, and preparing students to thrive in a diverse and interconnected world.

Using the *Culturally Sustaining Lesson Plan Template* (see Appendix A) is important for teachers so they may create an inclusive, engaging, and empowering learning environment that supports the academic, social, and emotional development of all students (Paris & Alim, 2017). Particularly for new teachers, a culturally sustaining lesson plan template will help create an inclusive learning environment where all students feel valued and their cultural identities are affirmed because the lesson will be designed to incorporate cultural content, examples, and activities that resonate with students' lived experiences, making the learning more meaningful and engaging (Ladson-Billings, 2014). The lesson will challenge students to think critically, explore multiple perspectives, and challenge assumptions. The culturally sustaining template will ensure diverse cultural viewpoints and experiences are included to help students develop a broader understanding of the world and promote empathy and respect for different cultures and backgrounds.

Ensuring a lesson is culturally sustaining involves intentionally incorporating practices that value and affirm students' cultural identities and experiences (Ladson-Billings, 2014). By intentionally integrating these strategies into the lesson planning and instruction, teachers will create culturally sustaining lessons that validate, engage, and empower students, fostering an inclusive and equitable learning environment. Using the *Culturally Sustaining Lesson Plan's*

Essential Questions (see Appendix B) as a guide will ensure that CSP is applied in the planning process. The essential questions were based upon the foundational elements of CSP:

1. Know Your Students: Develop a deep understanding of your students' cultural backgrounds, languages, and experiences. Recognize and respect the diversity within the classroom, including different ethnicities, religions, languages, and socio-cultural contexts.
2. Incorporate Students' Cultural Assets: Identify and acknowledge the cultural assets and strengths that students bring to the classroom. Integrate their cultural knowledge, experiences, and perspectives into the curriculum and instructional materials. This can be done by using diverse examples, case studies, literatures, and multimedia that reflect students' cultures.
3. Culturally Sustaining Instruction: Design instruction that connects to students' cultural contexts and makes the content meaningful and relatable. Use examples, analogies, and illustrations that resonate with students' lived realities. Incorporate culturally relevant activities, projects, and real-life connections to engage students and deepen their understanding.
4. Diverse Perspectives and Voices: Include diverse perspectives and voices in the curriculum. Incorporate literature, historical accounts, and contributions from different cultures and ethnicities. Highlight the achievements and contributions of individuals from marginalized communities to challenge stereotypes and broaden students' understanding of diverse cultures.
5. Authentic Resources: Use authentic resources that reflect the cultural diversity of your students. These can include primary sources, community-based knowledge, oral

histories, interviews, and multimedia materials produced by individuals from different cultures. Ensure the resources are accurate, respectful, and representative of the cultural groups they portray.

6. Culturally Sustaining Pedagogy: Adopt teaching strategies that promote active student engagement and participation. Encourage discussions that value and respect diverse perspectives. Incorporate cooperative learning, collaborative projects, and group activities that foster intercultural understanding, empathy, and respect among students.
7. Multimodal and Multilingual Instruction: Consider students' linguistic diversity and provide instructional materials in multiple languages when possible. Incorporate visuals, gestures, and other nonverbal communication strategies to support students' understanding. Provide opportunities for students to express their learning using different modalities, such as art, music, or digital media.
8. Culturally Sustaining Assessment: Use assessment practices that honor and value students' cultural identities and diverse ways of demonstrating learning. Provide alternative assessment methods that allow students to express their understanding using culturally sustaining approaches, such as storytelling, visual presentations, or performances.
9. Community and Family Engagement: Involve families and community members in the learning process. Seek their input, invite guest speakers from diverse backgrounds, and create opportunities for community partnerships. Collaborate with families to understand and incorporate cultural traditions, practices, and resources into the curriculum.

10. Reflect and Adapt: Regularly reflect on your teaching practices and lesson outcomes. Seek feedback from students, families, and colleagues to continuously improve and make adjustments that better meet the cultural needs and experiences of your students (Gonzalez et al., 2005; Ladson-Billings, 2014; Moll et al., 1992).

These foundational elements act as guiding principles to help ensure a culturally sustaining lesson is inclusive, empowering, and meaningful for all students, while honoring and respecting their diverse cultural backgrounds and identities (Paris & Alim, 2017). They foster positive identity development, engagement, critical thinking, and cultural competence among students. By embracing these principles, teachers can create transformative educational experiences that benefit all students. Transformative educational experiences (Mertens, 2010) have the power to inspire students, challenge their perspectives, and empower them to make positive changes in their lives and communities. By incorporating these strategies, teachers can create learning environments that foster deep learning, critical thinking, empathy, and personal growth.

Assessments Overview

The teacher will analyze data from formative and summative assessments to determine the individual needs of each student. Data from assessments will be analyzed for areas of reteaching and enrichment, using four guiding questions:

1. What do we want all students to know and be able to do?
2. How will we know if they learned it?
3. How will we respond when some students do not learn?
4. How will we extend the learning for students who are already proficient?

Daily assignments will be collected to assess students formatively.

The summative assessment will consist of student oral presentations of their lab projects to the class.

Semester Overview

In this science literacy elective, students will learn how organisms in an ecosystem interact with one another in complex feeding hierarchies of a food web. Students will build upon their knowledge to examine how matter and energy resources cycle from organisms and back into the environment. Students will make connections to how they are living beings in an ecosystem and are dependent on other living organisms, including each other, and on non-living resources in their biosphere. Students will also analyze how an unequal distribution of resources can affect their growth and survival.

The science readers (see Appendix C) outlined in the *Curriculum:* Exploring Science: Content and Literacy in Science table will be used to teach the targeted science content standards. The science readers present scientific concepts in a clear and comprehensible manner, breaking down complex ideas into digestible chunks. They provide explanations, examples, and visual aids that support students' understanding of key scientific concepts outlined in the content standards.

PBL (Krajcik et al., 2014) activities were designed in alignment with the state science standards covered in the science readers. These activities will encourage students to actively explore scientific phenomena, ask questions, make observations, and draw conclusions, fostering critical thinking and scientific inquiry skills.

CSP was used to frame the following lesson outline, to intentionally integrate students' cultural identities, experiences, and perspectives into the instructional design. The PBL (Krajcik et al., 2014) activities were incorporated to encourage students to explore scientific phenomena

within their cultural contexts. The PBL approach will encourage students to conduct research that incorporates their cultural knowledge and practices. This will promote student agency, critical thinking, and problem-solving skills by examining the social, cultural, and ethical dimensions of scientific knowledge and practices.

CSP (Paris, 2012) and PBL (Krajcik et al., 2014) will engage students in discussions about how science intersects with power dynamics, inequities, and cultural biases. Critical analysis of science concepts in the curriculum will encourage students to question dominant narratives and explore how science can be a tool for positive social change.

Proposed Timeline

The semester consists of two quarters, each are approximately 9 to 10 weeks long: Quarter 1 will take approximately 9 weeks from August 14, 2023, through October 13, 2023. Quarter 2 will take approximately 10 weeks from October 16, 2023, through December 22, 2022.

Quarter 1 Instructional Segment and Integrated Science Standards Topic:

Car Crashes

PS3–1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.

PS3–3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.

Book Titles:

- *Investigating Forces and Motion (Science Challenges)*
- *All About Mechanical Engineering*

Renewable Energy

ESS3–1. Obtain and combine information to describe that energy and fuels are derived from

natural resources and their uses affect the environment.

PS3–2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

PS3–4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

Book Titles:

- *Our Resources*
- *Powered by Steam*
- *From Sunshine to Light Bulb*
- *Energy*

Sculpting Landscapes

ESS1–1. Identify evidence from patterns in rock formations and fossils in rock formations and fossils in rock layers for changes in a landscape over time to support an explanation for changes in a landscape over time.

ESS2–1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

ESS2–2. Analyze and interpret data from maps to describe patterns of Earth's features.

ESS3–2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

Book Titles:

- *Fossils to Rocks*
- *Travel Adventures: The Grand Canyon*
- *Erosion and Sediments*

Earthquake Engineering

ESS2–2. Analyze and interpret data from maps to describe patterns of Earth's features.

ESS3–2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

PS4–1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.

Book Titles:

- *Earthquakes*
- *Predicting Earthquakes*
- *Saving Culture from Disaster*

PBL Topic: People + Community + Environment + Access to Resources Interconnections

Standards Overview: Students will learn how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. Students will evaluate data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. Students will also make connections to the factors that have caused the rise in global temperatures over the past century.

Student Project Idea: Students will construct an argument for how increases in human population and per capita consumption of natural resources impact Earth's systems. Students will create a Google slide presentation to share their findings with their class.

Project Expectations: Students will use the Claim, Evidence, and Reasoning (C.E.R.) writing format to construct and defend their argument.

- Students will provide evidence of human populations and the rates of consumption of food and natural resources from class resources and their own research sources.
- Students will infer their reasoning to the consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decision for the actions society takes.
- Students will make personal connections to how increases in human population and per capita consumption of natural resources may impact their individual lives based on where they live and their region's accessibility to resources.

Assessments:

Daily Assignments: Daily assignments will be collected to assess students formatively.

Summative Assessments: Students will present their C.E.R. writing to the class.

Quarter 1 Lesson Planning

Week 1: SEL & Ice Breakers; Student intake surveys

- Students will participate in Social, Emotional, and Learning activities to help build better relationships and interpersonal skills to use in and outside of class.
- Students will complete intake surveys to gain a baseline understanding of students' prior knowledge of science and to get to know students to incorporate in my funds of knowledge.

Week 2: *Car Crashes* book

- Students will use evidence from the reading to construct an explanation relating the speed of an object to the energy of that object.
- Students will make predictions about the changes in energy that occur when objects collide.

Week 3: *Renewable Energy* book

- Students will make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
- Students will apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

Week 4: *Sculpting Landscapes* book

- Students will identify evidence from patterns in rock formations and fossils in rock formations and fossils in rock layers for changes in a landscape over time to support an explanation for changes in a landscape over time.
- Students will make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

Week 5: *Sculpting Landscapes* book Continued

- Students will analyze and interpret data from maps to describe patterns of Earth's features.

- Students will generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

Week 6: *Earthquake Engineering* book

- Students will analyze and interpret data from maps to describe patterns of Earth's features.
- Students will generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.
- Students will develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.

Week 7: *Earthquake Engineering* book Continued

- Students will develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.

Week 8: Final Assessment Project

- Students will construct an argument supported by evidence for how increases in human population and per capita consumption of natural resources impact Earth's systems.
- Students will use the Claim, Evidence, and Reasoning (CER) format for writing.

Week 9: Final Assessment Project Due

- Students will present their CERs to their classes. Students will be given a rubric and graded based on Week 8's expectations.

Quarter 2 Integrated Science Standards Topic:

Animal Senses

LS1–1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

LS1–2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

Books:

- *Plant Reproduction*
- *Showdown: Animal Defenses*
- *Amazing Animals: Strange Animal Partnerships*

What is Matter Made Of?

PS1–1. Develop a model to describe that matter is made of particles too small to be seen.

PS1–2. Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.

PS1–3. Make observations and measurements to identify materials based on their properties.

PS1–4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

Books:

- *Composition of Matter*
- *Conservation of Mass*
- *The World of Elements and Their Properties*
- *Mixtures and Solutions*
- *Chemical Reactions*

From Matter to Organisms

LS1–1. Support an argument that plants get the materials they need for growth chiefly from air and water.

LS2–1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

PS3–1. Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.

Book titles and lessons:

Life and Non–Life in an Ecosystem ebook and lesson.

Life and the Flow of Energy ebook and lesson.

Digestion and Using Food ebook and lesson.

Interacting Earth Systems

ESS2–1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

ESS2–2. Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

ESS3–1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Book titles:

- *Earth's Cycles*
- *The Four Spheres of Earth*
- *The Powerful Ocean*
- *Spaceship Earth*

Patterns in the Night Sky

ESS1–1. Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distance from Earth.

ESS1–2. Represent data in graphical displays to reveal patterns of daily changes in the length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

PS2–1. Support an argument that the gravitational force exerted by Earth on objects is directed down.

Book titles:

- *Stars*
- *The Wonder of Our Solar System*
- *The Milky Way: A River of Stars*

Systems and Subsystems in Earth and LIfe Science

LS1–1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.

LS1–2. Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.

LS1–3. Use arguments supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

LS1–8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

Book titles:

- *Cells*

- *Looking Inside Cells*
- *Pioneers in Cell Biology*

Earth Systems Interactions Cause Weather

MS–ESS2–4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

MS–ESS2–6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.

MS–PS3–4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

Book titles:

- *Inside the Water Cycle*
- *Weather Scientists*
- *All About Energy*

Causes and Effects on Regional Climates

MS–ESS2–5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.

MS–LS1–4. Use arguments based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.

MS–LS1–5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

MS–LS1–8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

MS–LS3–2. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.

Book titles:

- *Investigating Storms*
- *The World of Plants*
- *The World of Animals*
- *DNA*

The World of Genetics

- *Gregor Mendel: Genetics Pioneer*
- *Investigating the Human Body*
- *All About Mitosis and Meiosis*
- *The World of Genetics*

Effects of Global Warming on Living Systems

MS–ESS3–3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

MS–ESS3–5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

MS–ETS1–1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

Global Warming ebook and lesson.

PBL Topic: Community + Access to Resources + Technology Interconnections

Standards Overview: Students will learn that substances are made from different types of atoms, which combine with one another in various ways to form substances. Students will learn about the different characteristics and properties molecules may have and how they react with one another. Students will examine chemical transformations and analyze how molecules are consumed, absorbed, and transferred from living things to the environment. With these cycles, students will make connections with metabolic reactions in the human body to explore how these reactions may lead to experiencing certain bodily symptoms, such as headaches and stomach issues. Students will also consider the impact these molecules may have, not just on living things, but the environment. Students will explore what impact may result when resources become scarce or nonexistent.

Student Project Idea: Students will build upon Quarter 1's PBL topic to include access to technology. Students will create a molecular model and discuss the composition of the substance, its structure, and society's use for it. Students will give an oral presentation about their models to their class.

Project Expectations: Students will build a molecular model using either a modeling kit, clay, foam, and/or other creative materials that the class has on hand or has access to at home. Students will be able to:

- Create a model to describe, test, and predict the reaction of their chosen molecule.

- Discuss the cause-and-effect relationships of their molecule that may be used to predict phenomena in natural or designed systems.
- Discuss the advantages and/or disadvantages their substance may bring to society.
- Discuss the impact their substance may have on the environment.

Assessments:

Daily Assignments: Daily assignments will be collected to assess students formatively.

Summative Assessments: Students will present their Google Slidedeck to the class.

Quarter 2 Lesson Planning

Week 1: *Animal Senses* book

- Students will construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
- Students use a model to describe how animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

Week 2: *What Is Matter Made Of?* book

- Students will develop a model to describe that matter is made of particles too small to be seen.
- Students will measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.

- Students will make observations and measurements to identify materials based on their properties.
- Students will conduct an investigation to determine whether the mixing of two or more substances results in new substances.

Week 3: *From Matter to Organisms* book

- Students will support an argument that plants get the materials they need for growth chiefly from air and water.
- Students will develop a model to describe the movement of matter among plants, animals decomposers, and the environment.
- Students will use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.

Week 4: *Interacting Earth Systems* book

- Students will develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
- Students will describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.
- Students will obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Week 5: *Patterns in the Night Sky* book

- Students will support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distance from Earth.
- Students will represent data in graphical displays to reveal patterns of daily changes in the length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.
- Students will support an argument that the gravitational force exerted by Earth on objects is directed down.

Week 6: *Systems and Subsystems in Earth and Life Science* book

- Students will conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.
- Students will develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.
- Students will use an argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.
- Students will gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

Week 7: *Earth Systems Interactions Cause Weather* book

- Students will develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

- Students will develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.
- Students will plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

Week 8: *Causes and Effects on Regional Climates* book

- Students will Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.
- Students will use arguments based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
- Students will construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
- Students will gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.
- Students will develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.

Week 9: *Effects of Global Warming on Living Systems* book

- Students will apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- Students will apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- Students will define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

Week 10: Final Assessment Project Due

- Students will build either a ball-and-stick, skeletal, or space-filling molecular model.
- Describe the purpose of the substance.
- Describe the molecular structure, shape, and bonding.
- Identify whether it is a synthetic material.
- Describe its reaction in particle motion, temperature and state when thermal energy is added or removed.
- Discuss the cause-and-effect relationships of their molecule that may be used to predict phenomena in natural or designed systems.
- Discuss the advantages and/or disadvantages their substance may bring to society.
- Discuss the impact their substance may have on the environment.

Students will present their molecular models to their classes. Students will be given a rubric and graded based on Week 8's expectations.

CHAPTER V: CURRICULUM EVALUATION

The assessment tool used to evaluate the effectiveness of CSP applied to the curriculum is based on the California Department of Education's descriptions (2023) for effective use of CSP in a classroom, which can be found on the California of Education's webpage https://www.cde.ca.gov/pd/ee/culturallysustainingped.asp. The rationale for using the state's guidelines as an assessment tool is to have consistency, accountability, and alignment with state assessments. The Principal and Academic Intervention Specialist will monitor and evaluate the curriculum at the midway points of the first and second quarters and at the end of the first semester.

By using California's educational standards, educators in this state are all held to the same expectations (California Department of Education, 2023). This helps guarantee all students have access to a quality education and are prepared for the same academic challenges. By aligning the curriculum with state standards, educators can ensure students are well prepared for state tests and the curriculum is meeting state expectations. By using the state's educational standards, you can demonstrate to state officials the curriculum is providing a quality education and meeting state expectations.

The California Department of Education's descriptions (2023) for effective use of CSP in a classroom is based on the scholarly work of Samy Alim and Django Paris (2017). Alim and Paris are scholars who have contributed significantly to the development of culturally sustaining education. The California Department of Education's descriptions for effective use of CSP are derived from Alim and Paris's key features of CSP. The key features they have identified as being important in culturally sustaining educational settings include valuing and building on students' cultural and linguistic resources, fostering critical consciousness, emphasizing

relationships and community building, incorporating culturally relevant pedagogy, and supporting student agency and voice.

Table 1

California Department of Education's Description of Effective Use of Culturally Sustaining Pedagogy in the Classroom

Feature	What it Looks Like
Valuing community languages, practices, and ways of being	Students' languages, literacies, and cultural ways of being are centered meaningfully and consistently in classroom learning instead of being considered as "add-ons."
Schools are accountable to the community	Educators and schools are in conversation with communities about what they desire and want to sustain through schooling.
Curriculum that connects to cultural and linguistic histories	Educators connect present learning to the histories of racial, ethnic, and linguistic communities both locally and nationally.
Sustaining cultural and linguistic practices, while providing access to the dominant culture.	Educators value and sustain the cultural and linguistic practices of the community while providing access to the dominant culture (white, middle class, and standard English speaking).

Note. California Department of Education. (2023). *Culturally sustaining pedagogy.* California Department of Education: Professional learning. Republished with permission from the CA DOE. See Appendix E).

Feature: Valuing Community Languages, Practices, and Ways of Being

Valuing community languages, practices, and ways of being is a key aspect of CSP. Implementation strategies to incorporate this feature are as:

1. The teacher will learn about the languages, practices, and ways of being of the students and their families. A lesson plan will incorporate opportunities for conversations, surveys, and other forms of communication for students to share this information. This

will help the teacher better understand the students' cultural backgrounds and experiences.

2. The teacher will incorporate community languages in the classroom. Community languages will be incorporated into the classroom by including them in signage, classroom materials, and other teaching resources. This will help students feel more comfortable and connected to their cultural identities.
3. Community members will be invited to share their practices and knowledge. Lessons will offer opportunities to invite community members to share their practices and knowledge with students. This can include inviting family members to share stories or teach songs or dances, or inviting local artists or cultural leaders to speak to the class.
4. The teacher will use culturally relevant materials and resources. Materials and resources that are culturally relevant and responsive will be used in the lesson planning process. This can include books, videos, and other resources that reflect the experiences of the students and their communities.
5. The teacher will foster a culture of respect and appreciation for diversity. The teacher will foster a culture of respect and appreciation for diversity in the classroom. This can include teaching students about different cultures, encouraging them to share their own cultural knowledge, and challenging biases and stereotypes (Paris, 2012, Paris & Alim, 2017).

By valuing community languages, practices, and ways of being, the teacher can create a more inclusive and culturally sustaining learning environment. This can help students feel more connected to their cultural identities, improve their academic performance, and support their overall well-being.

Feature: Schools are Accountable to Their Community

As institutions play a significant role in shaping the education and development of students, schools have a responsibility to ensure they are meeting the needs of the community they serve. This accountability can take many forms, such as providing transparent and timely communication with parents, ensuring the curriculum aligns with local and state standards, and providing opportunities for community involvement in the class decision-making processes. The relationship between the classroom and their communities is one of mutual accountability and support, with both parties working together to ensure the success of the students and the community as a whole.

Feature: Curriculum That Connects to Cultural and Linguistic Histories

A curriculum that connects to cultural and linguistic histories is one that recognizes and values the diverse cultural and linguistic backgrounds of students. It is important to acknowledge students come from different backgrounds and have different experiences, and to create a curriculum that reflects this diversity. Key elements that connects to cultural and linguistic histories are as follows:

1. Inclusive and representative texts: The curriculum will include texts that represent and celebrate the diverse cultural and linguistic backgrounds of students. This will include literature, poetry, and other texts that reflect the experiences of different cultures and communities.
2. Culturally sustaining teaching: The teacher will use teaching strategies that are culturally sustaining and responsive to the needs of students from different cultural and linguistic backgrounds. This includes incorporating cultural references, experiences, and perspectives into the curriculum.

3. Multilingual education: The curriculum will acknowledge and value the linguistic diversity of students and support the development of multiple languages. This will include offering bilingual or multilingual education and providing resources for students to learn and develop their home languages.
4. Cultural competence: The teacher will be sensitive to understanding and valuing different cultures and being able to effectively work with students from diverse backgrounds.
5. Community involvement: The curriculum will involve families and communities in the educational process, and value their input and perspectives.

The curriculum will connect to cultural and linguistic histories to recognize and value the diversity of students. This will create an inclusive and supportive learning environment that celebrates and honors different cultures and languages.

Feature: Sustaining Cultural and Linguistic Practices, While Providing Access to the Dominant Culture

Designing a curriculum to sustain cultural and linguistic practices while providing access to the dominant culture is important for promoting equity, inclusivity, and diversity in education. Ways in which the curriculum will incorporate these key principles are as follows:

1. Recognizing and valuing cultural and linguistic diversity: The lessons will recognize and value the cultural and linguistic diversity of its students. The lessons will incorporate and celebrate the rich cultural heritage of all students, including those from minority backgrounds.
2. Incorporating multiple perspectives: Lessons will be designed to provide access to the dominant culture and incorporate multiple perspectives, including those from minority

cultures. This will be achieved through the inclusion of texts, literature, and torah resources that reflect diverse perspectives.

3. Integrating cultural and linguistic practices: Integration of cultural and linguistic practices into the learning experience will be reflected in the lessons by incorporating personal narratives using storytelling, music, and other cultural practices into the curriculum.
4. Creating a culturally sustaining classroom environment: The classroom environment will be inclusive and welcoming to all students. This will be achieved through the use of culturally sustaining teaching practices, such as active listening, empathetic communication, and creating a sense of community in the classroom.
5. Providing language support: For students whose first language is not the dominant language, lessons will provide language support to ensure that all students have access to the curriculum. This will include providing bilingual resources, language instruction, and translation services.

The curriculum is designed to sustain cultural and linguistic practices while providing access to the dominant culture will be grounded in principles of equity, inclusivity, and diversity. By valuing and integrating diverse cultural and linguistic practices, the curriculum will provide a more holistic and enriching learning experience for all students.

Monitoring the fidelity of a curriculum ensures it is being implemented as intended and consistently. The individuals who make up the Instructional Support Team (IST) at the school will be asked to support in the evaluation of the curriculum using the above criteria. Strategies considered to monitor the fidelity of the curriculum are as follows:

1. Observation and Classroom Walkthroughs: The IST will be asked to conduct regular classroom walkthroughs and observations to directly observe curriculum implementation. The IST will provide feedback based on the observations.
2. Curriculum Meetings and Collaborative Planning: The teacher will hold collaborative planning sessions with other teachers and IST to discuss curriculum implementation strategies, share best practices using CSP, and address any challenges or concerns. These meetings will provide opportunities for professional dialogue and collective problem-solving.
3. Curriculum Documentation and Artifacts: Teacher will provide documentation of the curriculum implementation. The artifacts will be reviewed to assess alignment with the curriculum's goals, content, and instructional strategies.
4. Communication and Feedback Loops: The teacher will establish open lines of communication with the IST and other teachers offering support to gather feedback on curriculum implementation. The support time will be encouraged to provide input and express any concerns or needs related to the curriculum.
5. Continuous Improvement Cycle: The teacher will use the monitoring process as an opportunity for continuous improvement. The effectiveness of the curriculum implementation will be regularly assessed and adjustments will be made based on feedback. Engaging in the ongoing reflection and refinement will ensure fidelity and enhance the curriculum's impact.

By implementing these strategies, the teacher can effectively monitor the fidelity of the curriculum, receive support from other teachers and support staff, and ensure consistent and

high-quality implementation. This evaluation process will contribute to improved student learning outcomes and the overall success of the curriculum.

CHAPTER VI: DISCUSSION

Summary of Study

The purpose of this dissertation was to explore how principles of CSP (Paris, 2012) can inform the design of a junior high school curriculum to enhance science literacy in a meaningful way. CSP was used to build on and strengthen the cultural backgrounds, identities, and languages of students, rather than attempting to assimilate them into a dominant culture. The use of CSP in the creation of the curriculum was to build a more inclusive and equitable learning environment, where all students feel valued and supported in their learning.

CSP was used as a theoretical framework because it emphasizes the importance of recognizing and valuing students' cultural backgrounds and identities in the classroom (Paris, 2012). This approach acknowledges students come from diverse cultural and linguistic backgrounds and seeks to create learning environments that support and celebrate their cultural diversity. It is aimed at sustaining and nurturing the cultural identities of students while also promoting academic achievement (Berry & Candis, 2013).

A curriculum was developed for a sheltered science literacy elective class incorporating the principles of CSP while using the Backward Design Model (Wiggins & McTighe, 2005). In the context of CSP, the Backward Design Model was used to ensure instruction was culturally responsive, and honored and sustained the linguistic and cultural practices of all learners (Alim & Paris, 2017).

The goal of the curriculum was to enhance science literacy while developing students' cultural competence and honoring their linguistic and cultural identities (Alim & Paris, 2017). The PBL (Krajcik et al., 2014) approach was chosen as an assessment method to measure students' understanding and ability to demonstrate their knowledge in culturally sustaining ways.

The flexibility of PBL offers opportunities for students to develop their cultural competence through projects that honor their linguistic and cultural identities.

Implications

CSP can foster curiosity, promoting inquiry-based learning in science. CSP (Paris, 2012) encourages students to ask questions, investigate, and explore scientific phenomena from diverse perspectives. By incorporating students' cultural backgrounds, CSP taps into their existing knowledge, curiosity, and experiences, fostering a sense of ownership in their scientific exploration.

CSP (Paris & Alim, 2017) is an important tool for enhancing science literacy. By developing an understanding of science concepts and encouraging exploration and inquiry, CSP can help students become better readers and thinkers. As we continue to work towards improving education for all students, it is important to consider how CSP can be used to support and enhance learning.

In terms of science literacy, CSP has several implications. It recognizes science is not a culture-free or objective field, but rather is shaped by social and cultural contexts (Howe & Lisi, 2014). This means science curricula and instruction should be inclusive of diverse cultural perspectives, practices, and ways of knowing, in order to better engage students and promote science literacy.

Secondly, CSP emphasizes the importance of making science relevant and meaningful to students' lives and communities (Gonzalez et al., 2005). This involves connecting science concepts and skills to real world problems and issues students and their communities face, as well as incorporating local and cultural knowledge into science teaching and learning.

CSP (Paris & Alim, 2017) addresses equity and social justice. Culturally sustaining lesson plans contribute to a more equitable educational system. They challenge existing power dynamics and promote social justice by giving voice and agency to historically marginalized students (Howe & Lisi, 2014). These lesson plans help counteract stereotypes, biases, and discrimination, and empower students to critically examine social issues.

CSP is based on the premise that education should not only affirm the cultural identities of students but also empower them to become active participants in shaping their own educational experiences (Alim & Paris, 2017). This premise significantly impacts teacher efficacy in several ways. Teachers develop a deeper understanding and appreciation of the cultural backgrounds and experiences of their students. Accordingly, teachers can develop more meaningful and sustaining instructional strategies tailored to the needs and interests of their students. As a result, CSP supports the development of students' cultural competence and honors their linguistic and cultural identities.

CSP (Paris, 2012) has the potential to build positive teacher-student relationships. By incorporating students' cultural backgrounds into the lesson plan, teachers can establish stronger relationships with their students. It demonstrates a genuine interest in students' lives and creates opportunities for teachers to learn from their students. This fosters a positive and respectful classroom climate.

Suggestions for Further Research

CSP is an emerging field of research that seeks to support and empower students from diverse cultural backgrounds (Paris, 2012). Science education would benefit from further research in this area. The following are some suggestions for further research in this area.

There is a need for research that examines how CSP practices impact student learning outcomes, such as academic achievement, engagement, and identity development within a general education science classroom setting. Therefore, exploring the impact of CSP on student learning outcomes could have a positive impact on student performance.

There is a need to develop culturally sustaining assessments that take into consideration the cultural context of the students taking the tests. Current science assessments are often culturally biased. The knowledge about students' values, beliefs, practices, and experiences are often not considered when developing these assessments. There is a need to develop assessments that are culturally sustaining and inclusive of diverse cultural backgrounds.

More research should be done on investigating the role of teacher beliefs and attitudes in implementing CSP. Teachers' beliefs and attitudes towards CSP can significantly affect their implementation of these practices in the classroom. Research can investigate how to foster positive teacher attitudes towards CSP and how to support their implementation of these practices.

Examining the impact of CSP on teacher professional development could greatly benefit the educational community. CSP could also impact teacher professional development, as it may challenge teachers to rethink their assumptions and beliefs about science education. Research can investigate how CSP can support teacher professional development in science education. Studies could examine how CSP can help create collaborative, supportive, and effective teaching communities.

With the increasing use of online learning, there is a need to identify effective CSP practices for online science education, including how to create inclusive and culturally sustaining online learning environments. Research could examine how using multimedia resources,

simulations, and virtual labs can create more engaging and interactive learning experiences for their students, thus creating a collaborative and supportive online classroom.

Ultimately, I would like to see implementation of this curriculum development in a future study. I am curious to learn whether CSP can have significant effects on science literacy development among students. When students see themselves and their cultures reflected in the curriculum, will there be increased engagement? If students are more likely to be engaged in the learning process, will this lead to an increased motivation to read, write, and communicate?

If students are making personal connections to the texts they read, will this improve reading comprehension? If so, this approach could help students make sense of complex texts and develop critical thinking skills. Students feel seen, heard, and valued in the classroom when making personal connections to content. They are also more likely to perform well academically. Further research should be done to see if CSP can lead to improved academic performance in all subjects. What about suggesting PBL be made one of the best practices for achieving the California Science standards?

PBL can be an effective and valuable approach for achieving the California Science standards. PBL aligns well with the principles of NGSS, which emphasize the integration of science and engineering practices, crosscutting concepts, and disciplinary core ideas. PBL creates a dynamic and inclusive learning experience that aligns with the California Science Standards while honoring students' cultural identities and knowledge. Further research could reveal how this approach not only supports academic achievement but also promotes cultural competency, engagement, and equity in science education.

Reflections

CSP is an educational approach that seeks to maintain, support, and build upon the linguistic, literate, cultural, and community assets of students, particularly those from historically marginalized backgrounds (Paris & Alim, 2017). It does so by situating students' experiences and culture at the center of instruction and using those as a foundation for learning academic content. CSP prioritizes students' background knowledge and expertise, understanding every student has wisdom and knowledge to share and also have something to learn from one another.

Benefits to using CSP is it can be an effective way to engage all students in learning (Ladson-Billings, 2014). CSP recognizes the importance of students' cultural backgrounds and identities as a central aspect of their learning experience. This approach seeks to affirm and build upon these identities, rather than suppress or ignore them (Alim & Paris, 2017). When students see themselves and their culture represented in the curriculum, they are more likely to be motivated and invested in what they are learning.

CSP values collaborative and cooperative learning, encouraging students to work together to explore and understand complex ideas and concepts (Paris, 2012). This approach recognizes and values diverse forms of knowledge and ways of knowing, including those not traditionally recognized in mainstream educational settings. CSP involves families and communities in the learning process, recognizing the importance of their knowledge and experience in supporting students' educational success.

CSP also recognizes the importance of creating a culturally affirming learning environment where students' cultural identities and experiences are respected and valued (Alim & Paris, 2017). This can help to increase students' motivation and engagement in science learning and promote greater science literacy. Creating a powerful connection between

classroom lessons and diverse student backgrounds is at the forefront of CSP. It has the potential to help close achievement gaps between different groups of students.

When everyone is given an opportunity to learn about and celebrate their own cultures as well as the cultures of others, it breaks down barriers between groups of people (Gonzalez et al., 2005). Every student brings valuable perspectives and experiences to the classroom. By doing so, CSP is committed to advancing social justice and equity, working to challenge and dismantle systems of oppression and create more just and equitable educational environments.

CSP encourages teachers to incorporate culturally sustaining content, examples, and instructional strategies in science lessons (Paris & Alim, 2017). This approach can enhance students' understanding and application of scientific concepts by connecting them to their own cultural contexts and lived experiences. By studying the effectiveness of CSP, we can gain insights into which specific practices and approaches are most effective in promoting science literacy among diverse student populations.

Incorporating multicultural perspectives in science education is crucial for fostering a comprehensive understanding of scientific knowledge and practices. CSP acknowledges and values diverse ways of knowing and understanding the natural world. It encourages students to critically analyze scientific information from multiple cultural perspectives, promoting a broader and more inclusive view of science. Researching the impact of CSP on science literacy can provide evidence of how multicultural perspectives contribute to a deeper understanding of scientific concepts and improve overall science literacy.

Overall, CSP seeks to create educational spaces that are inclusive, respectful, and responsive to the diverse needs and experiences of all students. CSP can potentially have a positive impact on science literacy development by creating a more inclusive and culturally

sustaining learning environment that supports students in developing strong science literacy skills. This can be done through affirmation of students' identities, using culturally sustaining content while encouraging students to analyze and question cultural norms and assumptions. This approach will lead students to have a deeper understanding of themselves, their communities, and the world around them.

CSP is closely connected to social justice as it aims to address educational inequities, promote cultural empowerment, and challenge systems of oppression within education. CSP recognizes and values the cultural identities, experiences, and knowledge of all students. It seeks to create inclusive and equitable learning environments where students from diverse backgrounds feel affirmed, valued, and empowered. By addressing the unique needs and assets of each student, CSP promotes social justice by challenging inequities and ensuring access to quality education for all. By incorporating these principles, teachers can work towards creating educational environments that address social injustices and promote equitable opportunities for all students.

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APPENDIX A: CULTURALLY SUSTAINING LESSON PLAN TEMPLATE

A culturally sustaining lesson plan will be designed to promote and support the cultural identities and practices of all students in the classroom. Here is a template that can be used to create a culturally sustaining lesson plan. This template will be used as a guide and customized to meet the needs and interests of the students.

<table>
<tr><td colspan="3">Lesson Title:</td></tr>
<tr><td>Grade Level:</td><td>Subject:</td><td>Duration:</td></tr>
<tr><td colspan="3">Essential Question:</td></tr>
<tr><td colspan="3">Learning Objective:</td></tr>
<tr><td colspan="3">Materials(s):</td></tr>
<tr><td colspan="3">Procedures:
a. Anticipatory Set:

b. Instructional Input:

c. Guided Practice:

d. Independent Practice:

e. Closure:</td></tr>
</table>

Assessment Tool:
Differentiation:
Reflection:
Culturally Sustaining: a. Describe how the lesson plan will be inclusive and respectful of diverse cultures and identities. b. Explain how the lesson plan supports cultural sustainability. c. Identify any cultural biases or assumptions that the lesson plan may challenge or reinforce.
I. Backgrounds and Prior Experiences of Students:

APPENDIX B: CULTURALLY SUSTAINING LESSON PLAN'S ESSENTIAL QUESTIONS

The lesson plan should address the needs of all students in the classroom, including those from diverse cultural backgrounds (Paris, 2012). Here are some essential questions to consider when creating the lesson. By addressing these questions, a culturally sustaining lesson plan can help create an inclusive and equitable learning environment for all students.

1. How does this lesson plan build on the cultural backgrounds, experiences, and knowledge of all students in the classroom?
2. How does this lesson plan challenge and expand students' understandings of diverse cultures and perspectives?
3. How does this lesson plan encourage students to value and respect the cultural identities of themselves and others?
4. How does this lesson plan support the linguistic and cultural diversity of students in the classroom?
5. How does this lesson plan promote equity and inclusivity in the classroom, while also recognizing and celebrating diversity?
6. How does this lesson plan encourage critical thinking and engagement with social issues that affect diverse communities?
7. How does this lesson plan engage with local communities and incorporate local knowledge and resources?
8. How does this lesson plan empower students to use their voices and take action to create positive change in their communities?

9. How will the success of this lesson plan be measured, and what adjustments can be made to ensure that all students are supported and challenged in their learning?
10. Self–Reflection: Take time to reflect on your beliefs, values, and assumptions about teaching and learning. Consider how your own cultural background and experiences shape your instructional practices. Reflect on any biases or stereotypes you may hold and how they may influence your interactions with students.

APPENDIX C: CURRICULUM: EXPLORING SCIENCE: CONTENT AND LITERACY IN SCIENCE READERS

Instructional Unit	Science Standard	Title	ISBN	Guided Reading Level	Lexile Level
Car Crashes	4–PS3–1	Investigating Forces and Motion (Science Challenges)	978–0–7787–4253–1	R	990L
	4–PS3–1, 4–PS3–3	All About Mechanical Engineering	978–0–7439–0577–0	Y	770L
Renewable Energy	4–ESS3–1	Our Resources	978–1–4807–4689–3	S	730L
	4–ESS3–1	Powered by Steam	978–1–4938–6694–6	V	710L
	4–ESS3–1, 4–PS3–2	From Sunshine to Light Bulb	978–0–7787–2711–8	R	1,000L
	4–PS3–2, 4–PS3–4	Energy	978–1–4807–4605–3	R	450L
Sculpting Landscapes	4–ESS1–1	Fossils and Rocks	978–1–6181–0236–2	S	N/A
	4–ESS1–1	Travel Adventures: The Grand Canyon	978–1–4807–5808–7	S	690L
	4–ESS2–1, 4–ESS2–2	Erosion and Sediments	978–1–4994–2509–3	R	970L
Earthquake Engineering	4–ESS2–2, 4–ESS3–2, 4–PS4–1	Earthquakes	978–1–4333–0309–8	S	680L

	4–ESS3–2	Predicting Earthquakes	978–1–4938–6688–5	U	690L
	4–ESS3–2	Saving Culture from Disaster	978–1–4938–6681–6	R	610L
Earthquake Engineering	4–ESS2–2, 4–ESS3–2, 4–PS4–1	Earthquakes	978–1–4333–0309–8	S	680L
	4–ESS3–2	Predicting Earthquakes	978–1–4938–6688–5	U	690L
	4–ESS3–2	Saving Culture from Disaster	978–1–4938–6681–6	R	610L
Animal Senses	4–LS1–1	Plant Reproduction	978–1–4807–4676–3	Y	700L
	4–LS1–1	Showdown: Animal Defenses	978–1–4258–4983–2	R	700L
	4–LS1–2	Amazing Animals: Strange Animal Partnerships	978–1–4258–5555–0	S	800L
What is Matter Made Of?	5–PS1–1	Science Lab: Properties of Matter	978–1–6108–0295–6	U	780L
	5–PS1–2	Inside the World of Matter	978–0–7439–0567–1	P	N/A
	5–PS1–3	The World of Elements and Their Properties	978–0–7439–0581–7	Y	730L
	5–PS1–4	Mixtures and Solutions	978–1–4807–4721–0	Y	740L
	5–PS1–4	Chemical Reactions	978–1–4807–4724–1	Y	720L

From Matter to Organisms	5–LS1–1	Science Lab: The Life Cycles of Plants	978–1–6108–0293–2	U	710L
	5–LS2–1	Making an Ocean Ecosystem	978–1–4938–6720–2	U	750L
	5–LS2–1, 5–PS3–1	Life and the Flow of Energy	978–1–4807–4715–9	W	750L
Interacting Earth Systems	5–ESS2–1	Earth's Cycles	978–1–4807–4686–2	W	700L
	5–ESS2–1	Understanding Earth's Systems: Earth's Biosphere	978–1–5383–2985–6	T	N/A
	5–ESS3–1, 3–5–ETS1–1, 3–5–ETS1–2	Saving Migratory Birds	Saving Migratory Birds	V	820L
Patterns in the Night Sky	5–ESS1–2	Art and Culture: The Stories of Constellations	978–1–4807–5812–4	S	620L
	5–ESS1–2	Guided by Stars	978–1–4938–6718–9	W	800L
	5–PS2–1	Gravity	978–1–4807–4644–2	Q	710L
	5–PS2–1	Living and Working in Space	978–1–4938–6712–7	U	820L
Systems and Subsystems in Earth and Life Science	MS–LS1–1, MS–LS1–2, MS–LS1–8	Cells: Constructing Living Things	978–1–6819–1439–8	Z	N/A
	MS–LS1–2, MS–LS1–3	Animal Cells	978–1–5157–7263–7	Z	760L

	MS–ESS2–4	The Earth and the Role of Water	978–1–6181–0259–1	U	900L
	MS–ETS1–1	People and the Planet	978–1–6819–1438–1	Y	N/A
Earth Systems Interactions Cause Weather	MS–ESS2–4	Inside the Water Cycle	978–0–7439–0555–8	U	740L
	MS–ESS2–6	Investigating Storms	978–0–7439–0551–0	S	690L
	MS–ESS2–6	Tornado Chasers	978–1–4333–3463–4	T	N/A
	MS–ESS2–6	Hurricane Hunters	Hurricane Hunters	U	N/A
	MS–PS3–3	Solar Energy	978–1–6174–1540–1	U	950L
	MS–PS3–4	All About Energy	978–0–7439–0571–8	W	750L
	MS–PS3–5	What's Your Potential? The Energy of Motion	978–1–6819–1436–7	Y	N/A
Causes and Effects on Regional Climates	MS–ESS2–5, MS–ESS2–6	Climate Change	978–0–7534–7175–3	W	N/A
	MS–LS1–4, MS–LS1–5	Gregor Mendel: Genetics Pioneer	978–0–7439–0598–5	V	660L
Effects of Global Warming on	MS–ESS3–3, MS–ESS3–5	Planet Under Pressure: Too Many People on Earth?	978–1–4339–8644–4	X	N/A
	MS–LS1–5	Decoding Genes with Max Axiom, Super Scientist	978–1–4296–4862–2	W	GN750L

	MS–ETS1–1	Planet Under Pressure: Too Many People on Earth?	978–1–4339–8644–4	X	N/A

Note. This section contains the titles of the science readers students will read in class (Teacher Created Materials, 2023).

APPENDIX D: CURRICULUM: EXPLORING SCIENCE: CONTENT AND LITERACY IN SCIENCE READERS SCIENCE STANDARDS

Note. This section includes a list of California's Next Generation Science Standards covered in the curriculum (Next Generation Science Standards, 2012).

4–PS3–1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.

4–PS3–3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.

4–ESS3–1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.

4–PS3–2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

4–PS3–4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

4–ESS1–1. Identify evidence from patterns in rock formations and fossils in rock formations and fossils in rock layers for changes in a landscape over time to support an explanation for changes in a landscape over time.

4–ESS2–1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

4–ESS2–2. Analyze and interpret data from maps to describe patterns of Earth's features.

4–ESS3–2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

4–PS4–1. Develop a model of waves to describe patterns in terms of amplitude and wavelength

and that waves can cause objects to move.

4–LS1–1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

4–LS1–2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

5–PS1–1. Develop a model to describe that matter is made of particles too small to be seen.

5–PS1–2. Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.

5–PS1–3. Make observations and measurements to identify materials based on their properties.

5–PS1–4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

5–LS1–1. Support an argument that plants get the materials they need for growth chiefly from air and water.

5–LS2–1. Develop a model to describe the movement of matter among plants, animals decomposers, and the environment.

5–PS3–1. Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.

5–ESS2–1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

5–ESS3–1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

3–5–ETS1–1. Define a simple design problem reflecting a need or a want that includes specified

criteria for success and constraints on materials, time, or cost.

3–5–ETS1–2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet criteria and constraints of the problem.

5–ESS1–2. Represent data in graphical displays to reveal patterns of daily changes in the length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

5–PS2–1. Support an argument that the gravitational force exerted by Earth on objects is directed down.

MS–ESS2–5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.

MS–ESS2–6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.

MS–LS1–4. Use arguments based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.

MS–LS1–5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

MS–ESS3–3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

MS–ESS3–5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

MS–LS1–5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

MS–ETS1–1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

APPENDIX E: PERMISSIONS

Log Number

California Department of Education
Copyright Release Request

Date: June 2, 2023

Requestor Name:	Michelle Ramzan
Organization/Company Name:	Student, Antioch University
Location Address:	Personal: 12706 Lincolnshire Drive, Bakersfield, CA; University: Online
E-Mail Address:	
Telephone & Fax Number:	Cell Number: xxx-xxx-xxxx: No fax number.

Please provide thorough responses.
(*Use additional paper, if necessary*)

Provide a brief, specific narrative summarizing your request *(specificity is critical to a timely response)*.	I am a doctoral student writing a dissertation for a course at Antioch University. I am requesting permission to reuse a table: California Department of Education. (2023). Culturally sustaining pedagogy. California department of education: Professional learning.
Provide the title, item number, and publication date of the California Department of Education (CDE) publication(s) that you are requesting to reproduce/ translate/excerpt.	Culturally Sustaining Pedagogy table, "Feature & What it Looks LIke" located on website: https://www.cde.ca.gov/pd/ee/culturallysustainingped.asp There is no item number nor publication date. The website was last reviewed on Thursday, March 9, 2023
For copyrighted print materials, please attach a photocopy or PDF of the material to be copied. In addition, please provide a specific description of the material for which you are requesting copyright release, such as specific excerpts, page numbers, etc.	

Feature	What it Looks Like
Valuing community languages, practices, and ways of being	Students' languages, literacies, and cultural ways of being are centered meaningfully and consistently in classroom learning instead of being considered as "add-ons."
Schools are accountable to the community	Educators and schools are in conversation with communities about what they desire and want to sustain through schooling.
Curriculum that connects to cultural and linguistic histories	Educators connect present learning to the histories of racial, ethnic, and linguistic communities both locally and nationally.
Sustaining cultural and linguistic practices, while providing access to the dominant culture.	Educators value and sustain the cultural and linguistic practices of the community while providing access to the dominant culture (white, middle class, and standard English speaking).

	This table describes how teachers should demonstrate Culturally Sustaining Pedagogy and what it should look like during classroom observations.
For requests to stream copyrighted video excerpts online or on a server, please provide the title of the DVD, as well as the in and out times of the specific clips to be used that appear on the DVD counter (e.g., 10:23—13:42). For DVD series that have more than one disc, please specify the disc number, clip name, and the in and out times on the DVD counter.	N/A
Number of copies that you are requesting to reproduce.	1
Provide specific details of the intended use of the copyright materials.	I am requesting to reuse the table in my dissertation. My dissertation will appear in Proquest and dissertations and Theses databases. The thesis and dissertation databases my school uses are Ohiolink and Antioch University Repository and Archive. Here are the links to where it will be used: http://www.proquest.com/products-services/pqdt.html https://etd.ohiolink.edu/ http://aura.antioch.edu/
Provide the title of your pending publication.	How can principles of culturally sustaining pedagogy inform the design of a junior high curriculum to enhance science learning in a meaningful way?
If the materials are to be used for educational purposes, please provide the institution name, course name, course number, course pack and a sample lesson plan.	Institution name: Antioch University Online Course name: Dissertation Continuation Course number: EDU-8902X I am the student.
If the materials are intended for commercial use, please describe the	N/A

publication, number of items to be produced, and projected retail cost of your prospective publication.	
Provide any other information that may be helpful to CDE in expediting a response to your request. (For DVD requests: indicate how the participants will access the clips. Will they have to use a password to access the footage? Will they watch the footage streamed on the Web, or will they download the footage? Will the footage be available indefinitely or just for a period of time?)	The objective of this dissertation was to explore how the principles of culturally sustaining pedagogy (CSP) can inform the design of a junior high school curriculum to enhance science learning by providing meaningful learning experiences to all students. The transformative paradigm provided a framework used as a lens to emphasize the importance of understanding the social, cultural, and historical context in which individuals and communities are situated. CSP and Backward Design Model were applied to develop a curriculum for a sheltered science literacy elective class for below grade level readers. The purpose of using CSP in the curriculum design was to create a more inclusive and culturally sustaining learning environment that would support students in developing strong science literacy skills. Project-based learning (PBL) was used with CSP to allow for flexibility and creativity in project designs that give students the opportunity to explore and experiment with different ideas and approaches in the learning environment. The California Department of Education's descriptions for effective use of CSP in a classroom was incorporated into the curriculum to be used as an assessment tool measuring the effectiveness of the curriculum. The implications of this curriculum development suggest the effectiveness of CSP on science literacy and its connections enhance student performance in science.

CALIFORNIA DEPARTMENT OF EDUCATION

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STATE SUPERINTENDENT OF PUBLIC INSTRUCTION

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July 3, 2023

Michelle Ramzan

Log #: 23-011
Reference #: N/A

Re: An approval has been granted to use the "Feature & What It Looks Like" table from the California Department of Education Culturally Sustaining Pedagogy web page at https://www.cde.ca.gov/pd/ee/culturallysustainingped.asp for your doctoral dissertation as required by course EDU-8902X at Antioch University.

Maria S. Clayton

Digitally signed by Maria Clayton
DN: cn=Maria Clayton, o=California Department of Education, ou=Communications Division, email=mclayton@cde.ca.gov, c=US
Date: 2023.07.03 12:06:54 -07'00'

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MC/jm