

WHAT YOUR COLLEAGUES ARE SAYING . . .

“Sherita Flake powerfully conveys what is possible when STEM teachers show up as their whole selves and create space for their students to do the same. *Creating Inclusive STEM Classrooms* is packed with robust research and sample lessons that will speak to all readers. The principles and strategies outlined in this book align with how honoring students’ identity supports the brain’s inherent needs for deep meaningful learning.”

Liesl McConchie

Owner, Math With the Brain in Mind
Author, *Building a Positive Math Identity*
San Diego, CA

“This book is a much-needed resource for K–5 STEM educators who are committed to engaging in critical self-reflection, deeply understanding their own identities, and supporting their personal and professional growth. As a devoted parent and educator with much success in the STEM realm, Sherita Flake provides lessons and implementation guidance from elementary educators who have their boots on the ground and are doing the critical work of justice-oriented, liberatory STEM education.”

Christopher C. Jett

Associate Professor, Mathematics Education,
Georgia State University
Atlanta, GA

“*Creating Inclusive STEM Classrooms* is a must-read for K–5 teachers. By incorporating the cultural identity of students, Sherita Flake presents a way for every student to shine. Full of strategies, lessons, and research, this book provides a guide for teachers to identify exclusionary practices and cultivate a teaching environment that honors all students, including students with ADHD and autism. Every teacher would benefit from reading this book.”

Ruth Hughes

Former CEO, Children and Adults with Attention
Deficit/Hyper-Activity Disorder
Columbia, MD

“Sherita Flake has crafted a text that is timely and important during this moment in STEM education. She is adept at taking complex theoretical ideas and making them actionable. This text is historically rich and offers guided reflection for ALL teachers, especially culturally diverse STEM teachers who are often on the margins in education. The sample lessons are steeped in research, yet accessible, and the journal prompts support teachers in moving from reflection to action.”

Toya Jones Frank

Associate Professor, George Mason University
Fairfax, VA

“Through a deep dive into culture, Sherita Flake argues for pedagogy that integrates students’ cultural background into STEM teaching. She not only examines the theoretical nature of culture and learning but also provides practical applications to guide STEM teachers in implementing culturally aligned teaching. This book will be an invaluable resource for STEM educators who care about unlocking opportunity and ensuring access for culturally and linguistically diverse learners.”

Altheria Caldera

Senior Professorial Lecturer, American University
Barnesville, GA

“Sherita Flake offers a practical guide that explores STEM education through identity, belonging, and agency. Grounded in justice and cultural affirmation, this book empowers educators to create liberatory classrooms where every child's brilliance is recognized and nurtured. A must-read for teachers committed to equity and joy in STEM learning.”

Edmund Adjapong

Associate Professor, Seton Hall University
South Orange, NJ

“This powerful resource reimagines early education as a space for belonging, identity, and liberation. Grounded in justice-centered teaching, it empowers educators to nurture every child's voice, creativity, and curiosity while transforming classrooms into inclusive communities where difference is celebrated and all learners are seen, valued, and affirmed.”

Antonio Ellis

Senior Professorial Lecturer, American University
Washington, DC

“Readers will be taken on a deep dive into the intricacies of how one’s cultural identity shapes STEM teaching and learning. This is an instruction manual on how to improve both.”

Deanna McClung

Science Department Chair,
Chemical Hygiene Officer,
HS PLTW Coordinator, Elkhorn Area HS
Elkhorn, WI

“This book allows teachers to investigate how their identities, and those of their students, affect STEM learning, and encourages them to leverage their understanding for better learning.”

Amanda Clapp

Teacher, The Catamount School
Cullowhee, NC

Creating Inclusive STEM Classrooms

Creating Inclusive STEM Classrooms

Claiming Place and
Making Space in Grades K–5

Sherita Flake

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Corwin
A Sage Company
2455 Teller Road
Thousand Oaks, California 91320
(800) 233-9936
www.corwin.com

Sage Publications Ltd.
1 Oliver's Yard
55 City Road
London EC1Y 1SP
United Kingdom

Sage Publications India Pvt. Ltd.
10th Floor, Emaar Capital Tower 2
MG Road, Sikanderpur
Sector 26, Gurugram
Haryana - 122002
India

Sage Publications Asia-Pacific Pte. Ltd.
18 Cross Street #10-10/11/12
China Square Central
Singapore 048423

Vice President, Content and
Product: Monica Eckman
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Videos may also be accessed at
<https://companion.corwin.com/courses/InclusiveSTEMClassrooms>

PREFACE

HOW TO USE THIS BOOK

This book functions as both a critical self-reflection guide and an instructional resource. It supports K–5 STEM educators in developing a deeper understanding of their own cultural identities while learning to create STEM classrooms that are inclusive, relational, and rooted in justice. The purpose of this book is twofold: to promote personal growth and support the development of liberatory teaching practices that allow every student to thrive, especially those who have experienced exclusion or erasure in traditional STEM environments.

Each chapter includes reflection prompts designed to guide readers through structured critical self-reflection into their own cultural identities and pedagogical practices. These prompts support the development of liberatory agency and foster the confidence required for transformative teaching. Critical self-reflection creates the conditions for educators to recognize their own power and use it with clarity and purpose.

In addition to these prompts, each chapter includes examples of how to enact principles of cultural identity affirming pedagogy and sample STEM lessons. These lessons have already been taught in K–5 classrooms. They include implementation guidance based on the experiences of practicing educators. Every lesson emerged from a real classroom and reflects the voices and choices of teachers who hold student brilliance as a core value.

Throughout the book, readers will encounter authentic teacher vignettes. Each vignette reflects the lived experiences of educators who have contributed their voices, their classrooms, and their professional wisdom to this work. Readers are invited to embrace the stories of each of the teachers. They are encouraged to feel the pulse of their practice, to engage with their choices, and to learn from their clarity and conviction.

This book centers the brilliance of Black, Indigenous, and educators of color. At the same time, it calls all educators into the work of transformation. The creation of justice-centered STEM spaces requires solidarity. It requires accomplices and co-conspirators who are willing to learn, to listen, and to act. The strategies and stories in this book offer a pathway for every

educator who seeks to create classrooms where every child can belong, contribute, and thrive.

I encourage you to read this book with intention. Return to it often. Bring this book into conversation with colleagues and community members. Use it to elevate diverse approaches to learning, restore purpose, and imagine new possibilities for STEM education.

DEFINING STEM IN K–5 CLASSROOMS

This book defines STEM education as instruction in science, technology, engineering, and mathematics, whether taught as stand-alone subjects, through cross-curricular integration, or as a traditional STEM course. In alignment with the National Science Foundation (NSF), STEM includes content knowledge along with the skills, inquiry processes, and habits of mind that students use to engage with real-world problems. STEM teaching promotes curiosity, problem-solving, collaboration, and design thinking. All these elements can be developed across K–5 classrooms.

In many elementary schools, teachers in Grades K–2 teach all core subjects, while teachers in Grades 3–5 are often departmentalized or have dedicated STEM instructional blocks. This organizational structure can unintentionally position STEM as something reserved for upper elementary. As such, K–2 teachers may feel left out of the STEM space.

This book celebrates and welcomes the expertise of **all** elementary STEM educators, especially K–2 educators. K–2 teachers have a strong understanding of how to develop developmentally appropriate STEM lessons that honor the cultural identities of students. Their work lays the early foundation for curiosity, inquiry, and confidence in STEM. At the same time, 3–5 teachers provide essential content knowledge and help students apply STEM thinking to more complex problems. Every teacher in Grades K–5 plays an essential role in shaping equitable and identity-affirming STEM experiences for all learners.

ABOUT THE LANGUAGE

The language used throughout this book reflects a deliberate commitment to cultural identity affirmation and justice. Every word was chosen to center the humanity, brilliance, and dignity of educators and students, particularly those from historically marginalized communities. The language speaks the truth without compromising the lived experiences of people who have been consistently marginalized in STEM.

This book uses capitalization when referring to Black people within the African Diaspora. This choice recognizes the significance of Blackness across

generations and geographies. It affirms the value of Black contributions to society, including those in science, technology, engineering, and mathematics.

The term *Latinx* is used in this book to acknowledge and affirm the full gender spectrum within Latin American communities. This choice reflects my commitment to cultural identity affirmation. Using *Latinx* creates an inclusive, justice-centered STEM space where every cultural identity is seen, valued, and respected.

Educators who read this text will encounter language that affirms Black, Indigenous, and People of Color (BIPOC) communities while inviting all readers to reflect on their role in creating more just learning environments. This language may honor nontraditional paths to success, which may prompt discomfort. It may also invite healing, insight, and renewed purpose. Readers are encouraged to remain open. Let the language deepen understanding, strengthen connection, and affirm the truth that every voice, every cultural identity, and every way of knowing deserves space in STEM education.

ACKNOWLEDGMENTS

This book is possible because of the unmerited grace and spiritual gifts given to me by my Lord and Savior, Jesus Christ. I remain forever grateful for “my people,” who have always supported my dreams, affirmed my vision, and reminded me of my purpose.

To my family, Derek, Taylor, Caela, Makenzie, David, Chris, David Solomon, and Zoe Grace, thank you for everything. To my late grandmother, Mattie, thank you for being my first supporter, believing in me, and being my first STEM teacher.

I am forever grateful for my scholarly community. Thank you, Dr. Shereen Holmes, Dr. Lou Matthews, Dr. Rebecca Lubin, Dr. D’Andrea Heggs, and Kimberly Jordan. I also thank the many educators I interviewed anonymously while writing this book: I appreciate your support.

To the STEM educators, students, families, and community members, especially those from Black, Indigenous, and communities of color who have been historically marginalized, thank you for inspiring my vision. Your stories, resistance, and joy matter. It is at the center of this book.

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Teacher, The Catamount School
Sylva, NC

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Director, Outreach and Dissemination, Knowles Teacher Initiative
Bowie, MD

Daniel Edelen
Assistant Professor of Elementary Mathematics Education
Atlanta, GA

Lyric Flowers-White
Educator, Memphis Shelby County Schools
Southaven, MS

Shereen Holmes
Senior Professorial Lecturer
Mills, MD

John F. Mahoney
Member, National Teachers Hall of Fame
Bethesda, MD

Deanna McClung
Science Department Chair,
Chemical Hygiene Officer,
HS PLTW Coordinator, Elkhorn Area HS
Elkhorn, WI

Whitney Ricker
Educator, Williamson County Schools
Spring Hill, TN

ABOUT THE AUTHOR



Dr. Sherita Flake, a Memphis native, is a senior professorial lecturer and MAT program director at American University. She is dedicated to urban education and is known for her cultural identity research in STEM and leadership. As a wife and mother of three daughters, her family's experiences underscored the importance of cultural identities and agency. Dr. Flake's research and personal journey as a Black woman in STEM with Autism Level I and ADHD influenced her conceptual framework on cultural identity,

benefiting historically marginalized groups. Her findings have been widely received and adopted both nationally and internationally.

Before American University, she served as clinical faculty of mathematics at Johns Hopkins University and was an instructional leader in K–12 school districts across Tennessee, Virginia, Michigan, California, and the District of Columbia. She actively participated in educational committees, including Educational Testing Service (ETS) Standards Setting Committees, the Maryland State Department of Education Expert Review Team, and the Office of the State Superintendent of Education's (OSSE's) Review Team, and earned prestigious awards such as the Governor's Award of Excellence in Virginia, EPIC Gold status in Tennessee, and the Bryan K. Ingram Award for Leadership at Johns Hopkins University. Dr. Flake, along with her youngest daughter, Makenzie, co-authored *Stem Includes Me*, a publication aiming to help all students discover their identities in STEAM careers.

PART I

.....

FOUNDATIONS

CHAPTER 1

.....

A JOURNEY TO LIBERATION

In this chapter, we will answer the following questions:

- 1. In what ways does cultural identity humanize STEM education?*
- 2. How do the Four Dimensions of Cultural Identity welcome new ways of knowing, learning, and teaching in STEM?*

Have you ever taken a moment to think about how the strengths of your cultural identities empower you within the science, technology, engineering, and mathematics (STEM) community?

Zaria is a first-generation Afro-Caribbean educator raised in a single-parent household. Her cultural identities deeply shaped her journey to becoming a STEM teacher. She had always excelled in school, participating in STEM magnet programs from a young age. However, despite her credentials and expertise, Zaria was often overlooked for STEM teaching assignments. Her visible tattoos, facial piercings, and biker-inspired attire were in opposition to the unspoken standards of professionalism in the school environment.

What others overlooked, however, was that her motorcycle club was more than just a social group. They were the opposite of misfits looking for trouble. Her motorcycle club was a community rooted in mechanics and technology. From learning how engines functioned to leading community service projects focused on sustainability and fuel efficiency, Zaria developed a profound, hands-on understanding of STEM long before entering a classroom. Each year, she and her motorcycle club collaborated with a local nonprofit to host a STEM Day for elementary students. They created workshops that linked concepts like physics to real-world problem-solving using motorcycles.

When Zaria was finally assigned to teach STEM, she approached the role feeling like an impostor. At first, she attempted to assimilate by getting rid of anything that showed her connection to her motorcycle club. Her instructional coach encouraged her to reconsider and embrace her true self. Zaria's coach, whose uncle had also been part of a motorcycle club, understood the engineering potential in Zaria's life experiences. Together, they co-designed an upcoming lesson that incorporated her knowledge of motorcycles and her students' passion for sports cars. Students explored how

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force and speed work together, using their newfound understanding to design and build cars for an upcoming class competition. Suddenly, STEM became tangible and relevant for both Zaria and her students. It was meaningful and culturally significant.

This experience transformed Zaria's approach to teaching. She began to view her cultural identity as a bridge to STEM. Her cultural identity provided her with the resources to humanize STEM and cultivate a community where students could explore content through their lived experiences. By incorporating mechanical expertise from her biker community into classroom instruction, her students surpassed mandated learning objectives by fostering an environment of inquiry through trust, connection, and authenticity.

Multidimensional cultural identity refers to the intersecting cultural identities that influence how we navigate the world. This perspective celebrates the idea that we are neither monolithic nor defined by a single identity. It acknowledges that we comprise multiple coexisting identities that can shift in prominence depending on the context.

Cultural identity is a construct that embodies four dimensions to represent who we are through the core of our being, social affiliations, outward appearances, and ancestral lineage. It reflects how individuals understand themselves in relation to their community, history, and lived experiences. Cultural identity shapes how we engage with the world, how we perceive others, and how others perceive us in return, as well as how we navigate and contribute to the systems that surround us.

Agency involves recognizing and leveraging one's power to drive change through the assets rooted in one's multidimensional cultural identities.

Zaria's journey illustrates the power of cultural identity in STEM education. When we humanize teachers and students, foster thriving communities, and empower everyone to recognize and activate the agency rooted in their cultural identities, we strengthen the power of cultural identity. It moves beyond teachers rewarding those who can memorize the most content or master rigid standards. Understanding and embracing **multidimensional cultural identity** in STEM is essential for recognizing **cultural identity** and how it contributes to a thriving community, as well as **agency** (Collins, 2000; Crenshaw, 2017; Flake, 2023a, 2023b; Flake & Lubin, 2024; Hall, 2015; Tatum, 2021). By reclaiming the knowledge that had long existed outside the classroom walls, Zaria expanded the possibilities of what teaching STEM could be. In doing so, she opened the door for her students to do the same.

Zaria's story is all too common. False narratives have conditioned many teachers to believe their cultural identities are obstacles rather than **assets** in STEM. Therefore, it is imperative for everyone to actively honor what has been hidden in STEM so we can expand STEM to reflect its diversity.

UNDERSTANDING THE CONNECTION BETWEEN CULTURAL IDENTITY AND STEM EDUCATORS

As STEM educators, whether teaching math and science to first graders or leading an after-school robotics club, our role extends beyond delivering the mandated curriculum. When we focus solely on the curriculum, we miss the opportunity to reflect on how our unique cultural identities contribute to and enhance the field of STEM, as well as who we are within it. Taking time to critically reflect on our cultural identities dismantles illusions of hierarchy and increases teacher agency, particularly for STEM teachers from historically underrepresented backgrounds.

Assets are the strengths, wisdom, values, and gifts that we uniquely hold because of our cultural identity.

The burdens of maintaining exclusive structures that marginalize historically underrepresented teachers and students, along with the pressures of implementing curriculum and standards, and the demands of teacher evaluation systems, often overshadow any available time for critical self-reflection. Engaging in **critical self-reflection** enables us to recognize the assets of our cultural identities, which are essential for building inclusive STEM classrooms and strengthening a diverse teacher pathway (Dumas, 2016; Flake, 2023a, 2023b; Flake & Lubin, 2024; Freire, 2014; Jemal, 2017; Watts et al., 2011). When we understand the intersectionality of our cultural identities as STEM educators, we unlock new ways of showing up to teach and navigating systems within academic settings. Ultimately, we pave the way for inclusive practices that support the growth and development of a diverse STEM teacher pipeline.

Critical self-reflection involves the practice of examining how our cultural identities shape our thoughts, relationships, and actions. Engaging in this type of reflection helps educators understand how their identities intersect, shaping their teaching practices and connections with students. Likewise, engagement in critical self-reflection supports students in building self-awareness, community, and agency.

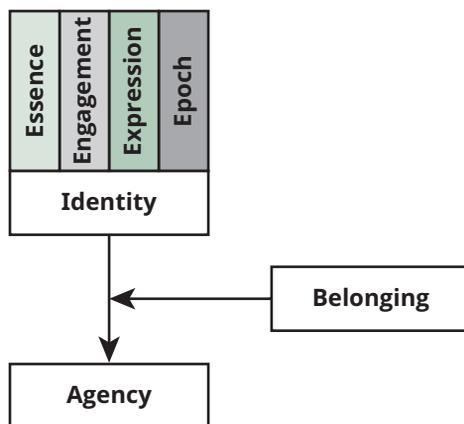
Understanding and embracing multidimensional cultural identities is essential to cultivating identity, belonging, and agency in STEM education, which can be defined as follows:

- **Identity:** Who we are and how we recognize the assets of our multidimensional cultural identities.
- **Belonging:** How the assets of our multidimensional cultural identities are recognized and valued in the community.
- **Agency:** The power to leverage the assets of our multidimensional cultural identities to create change.

Four Dimensions of Cultural Identity is a construct that categorizes every aspect of one's cultural identity into four dimensions: essence, engagement, expression, and epoch (Flake, 2023a, 2023b; Flake & Lubin, 2024).

I wrote this book to empower educators to create STEM instruction that celebrates diversity and fosters equity. Using the **Four Dimensions of Cultural Identity**, I will guide us in exploring our cultural identities and demonstrate ways to apply that understanding to build meaningful connections with students.

FIGURE 1.1 IDENTITY-BELONGING-AGENCY (IBA)



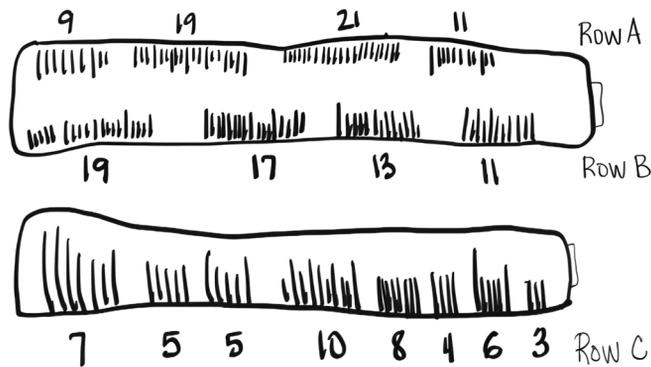
As shown in **Figure 1.1**, Identity–Belonging–Agency (IBA) helps educators develop identity, belonging, and agency in STEM classrooms. This research-based framework, grounded in the Four Dimensions of Cultural Identity, will guide us throughout this book, encouraging reflection on our cultural identities and how to utilize them to build more meaningful relationships with students through empowering STEM lessons. I will explore each component in more detail as we move through this book to make the connection between who we are and how we teach.

WHY MULTIDIMENSIONAL CULTURAL IDENTITIES ARE ESSENTIAL IN STEM EDUCATION

Diverse cultural contributions, including the early mathematical advancements of African, Asian, and Indigenous civilizations, as well as the agricultural and engineering innovations of Black, Latinx, and Indigenous communities, have profoundly influenced the historical evolution of STEM. However, manufactured systems of acceptance, grounded in historical structures of power and cultural dominance, privileged those with access to Eurocentrically framed STEM knowledge while systematically excluding the

rich STEM contributions of non-Western communities and limiting access for those from historically marginalized backgrounds (Flake, 2023b). As a result, once integral to scientific and technological progress, African and Indigenous knowledge systems were reframed as alternative knowledge systems and ultimately erased from mainstream curricula despite their continued relevance and innovation (Joseph, 2011).

The Ishango Bone originated in what is now the Democratic Republic of Congo. It shows early mathematical reasoning dating back approximately 22,000 years. Its engraved notches demonstrate numeric understanding rooted in pattern recognition and computation. Despite its mathematical sophistication as the first calculator, Western scholars labeled the bone as decorative because they believed advanced computation originated in Greece and the Middle East (Y, 2013).

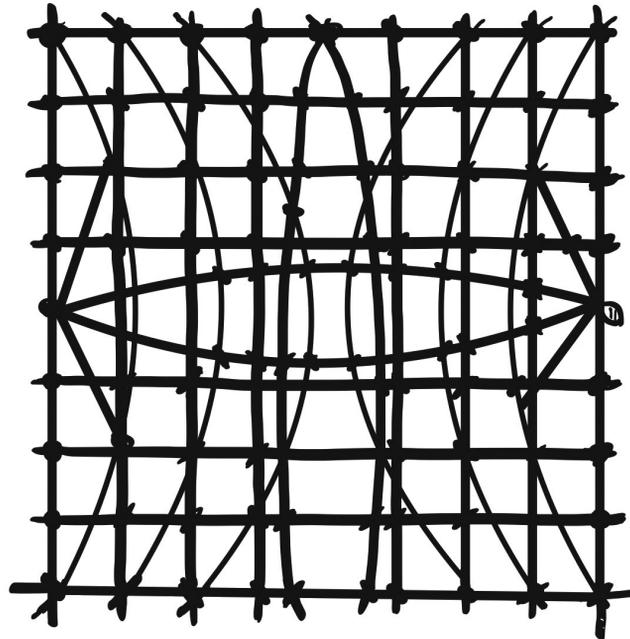


Similarly, calabash bowls were used across Africa for mixing, grinding, and storing plant-based medicines. These tools, central to traditional healing practices, were demonized and replaced by Western pharmaceutical systems (Abdullahi, 2011).



SOURCE: istock.com/hipokrat

Stick charts from the Marshall Islands, Micronesia, were sophisticated navigation tools used to map ocean currents and swell patterns. Western explorers erased their scientific value due to racist assumptions about Indigenous intelligence (M. Brown, 2019). Together, these objects demonstrate how dominant systems marginalized culturally rooted scientific tools, even though they clearly demonstrated cognitive sophistication and scientific expertise.



The brilliance and transformative potential of diverse cultural contributions to STEM were deliberately erased for generations in American education, beginning with the founding of the first American public school and ending with the landmark 1954 U.S. Supreme Court decision *Brown v. Board of Education of Topeka* (Ladson-Billings, 2006; Lynn & Dixson, 2021; Milner, 2013). Laws and policies reinforced deficit discourse and narratives about the cognitive and decision-making abilities of Black people, especially those born of African descent. Such laws and practices fostered systemic exclusion from STEM fields. While policies sought to diminish the intellectual contributions of Black scholars, the Black community continued to challenge these narratives while preserving and advancing STEM knowledge within their communities. However, culturally hegemonic norms and racialized epistemologies privileged those with access to Eurocentrically framed STEM knowledge (Dumas & Ross, 2016; Flake, 2023b; Jett, 2012; McLaren, 1995; Melamed, 2011).

These false narratives also shaped mindsets around who society perceives as the holder of knowledge and who belongs in STEM. Consequently, STEM became an exclusive field dominated by white males. Although the residue of these historical barriers still exists today through the underrepresentation of historically marginalized groups in STEM education, educators and scholars from historically marginalized communities continue to reclaim space in STEM by challenging exclusion and reshaping the field for future generations.

The impact of historical erasure extends beyond being theoretical. Historical erasure is evident in the lived experiences of marginalized individuals and shapes the way they navigate STEM spaces. As seen in Zaria's experience, **culturally acquired knowledge** can transform the acquisition of STEM knowledge. When teachers embrace their full identities, they redefine what STEM looks like for themselves and their students (Aragaki & Milks, 2026).

Culturally acquired knowledge refers to the informal, experience-based understanding passed down through families, communities, and cultural traditions. It encompasses ways of knowing that are rooted in lived experience and cultural practices, yet are often excluded or devalued in formal academic and institutional settings.

This approach cultivates inclusive narratives, broadens STEM knowledge, and affirms that all identities are valid entry points into the STEM field. When STEM education acknowledges and values the strengths and innovations of multidimensional cultural identities, it broadens the scope of STEM knowledge, its definition, teaching, and application. Integrating diverse cultural perspectives moves beyond rigid, Eurocentric thinking supported by dominant culture, dismantling either/or thinking and embracing the foundational contributions of historically excluded communities. Expanding STEM knowledge means recognizing oral storytelling, musical rhythms, and other cultural traditions as legitimate pathways for applying STEM theories, teaching concepts, and demonstrating mastery. This stretches beyond inclusion. It is a declaration that every aspect of our cultural identity is meaningful and necessary in shaping the future of STEM.

Beyond enhancing instruction, recognizing multidimensional cultural identities within STEM classrooms fosters a sense of belonging and strengthens representation (Berry & McClain, 2014; Flake, 2023a; Flake & Lubin, 2024; Ireland et al., 2018; McGee, 2014). When culturally diverse STEM educators bring their whole cultural selves into the classroom, they model for students that cultural identity and STEM are connected. They also model that their racialized cultural identities are nuanced; they are not monolithic. Recognizing cultural assets and creating opportunities to use them to uplift one's community strengthens belonging and representation in meaningful ways. Research consistently suggests that historically marginalized students

are more likely to persist in STEM fields when they see themselves reflected in their educators and instructional mentors (Flake, 2023a, 2023b; Flake & Lubin, 2024; Lindsay, 2020; Leggett, 2020; Packard & Fortenberry, 2016). When a STEM classroom community honors the assets of students' identities through culturally affirming experiences, students develop a belief that they belong in STEM.

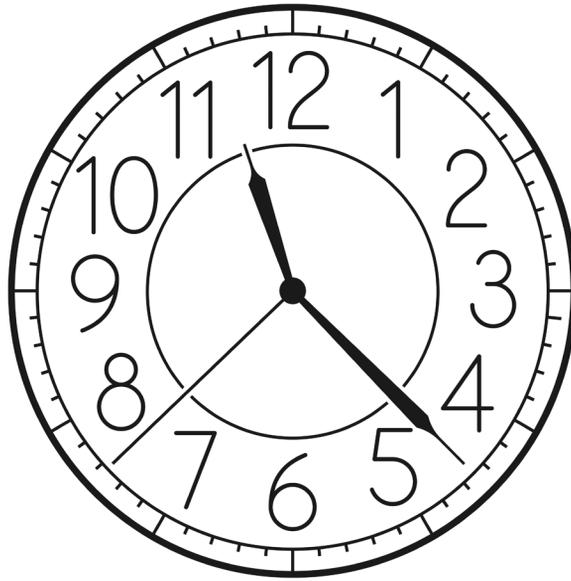
Furthermore, embracing multidimensional cultural identities empowers educators to become agents of change in STEM education. When teachers see the value in their cultural identities, they understand their agency. They are more equipped to design culturally relevant curricula, advocate for inclusive policies, and mentor students in ways that affirm their cultural identities. This creates a ripple effect. Educators who recognize and leverage the assets of their multidimensional cultural identities better position themselves to liberate students to enact change as well. As a result, empowered educators are transformative. They cultivate classrooms where inquiry, experimentation, and self-expression inspire systemic change in oppressed spaces.

By affirming multidimensional cultural identities, STEM educators reclaim their agency, foster inclusive classrooms, and drive meaningful change in how STEM is taught and experienced. To transform STEM education, we can engage in critical self-reflection, both individually and collectively, and advocate for systemic change. This transformation requires us to reimagine it as a space where everyone recognizes all identities as assets rather than barriers. Through this reimagining, STEM education can become a space where all students and educators belong and thrive.

EARLY STEM EXPOSURE BUILDS INCLUSIVE COMMUNITIES FROM THE GROUND UP

High-quality K–5 STEM education lays the groundwork for equity-focused teaching that supports early academic development, cultural belonging, and a strong sense of agency. Early exposure shapes how children see themselves in relation to STEM. These impressions begin to form as early as prekindergarten, influencing beliefs about who belongs in STEM fields (Handelsman & Smith, 2016; Master, 2021; Miller et al., 2024).

Students benefit most when learning experiences connect with their cultural identities. When teachers design lessons that reflect the lived experiences of students, children become more engaged and confident. For example, students can learn that correctly sorting laundry prevents unwanted color reactions; looking at an analog clock illustrates a double number line, and blowing bubbles shows how surface tension and geometry work. These activities help them see that STEM is already an integral part of their lives and support their academic growth. They encourage children to see themselves as capable problem solvers who can contribute to their communities through STEM.



SOURCE: istock.com/filo

National efforts have underscored the importance of early exposure to STEM education. During the Obama administration, the “STEM for All” initiative focused on broadening access to high-quality STEM education, particularly for students from historically underrepresented communities. The White House emphasized the long-term value of early STEM exposure, explaining that it strengthens learning across subjects and helps students develop essential skills from a young age (Handelsman & Smith, 2016).

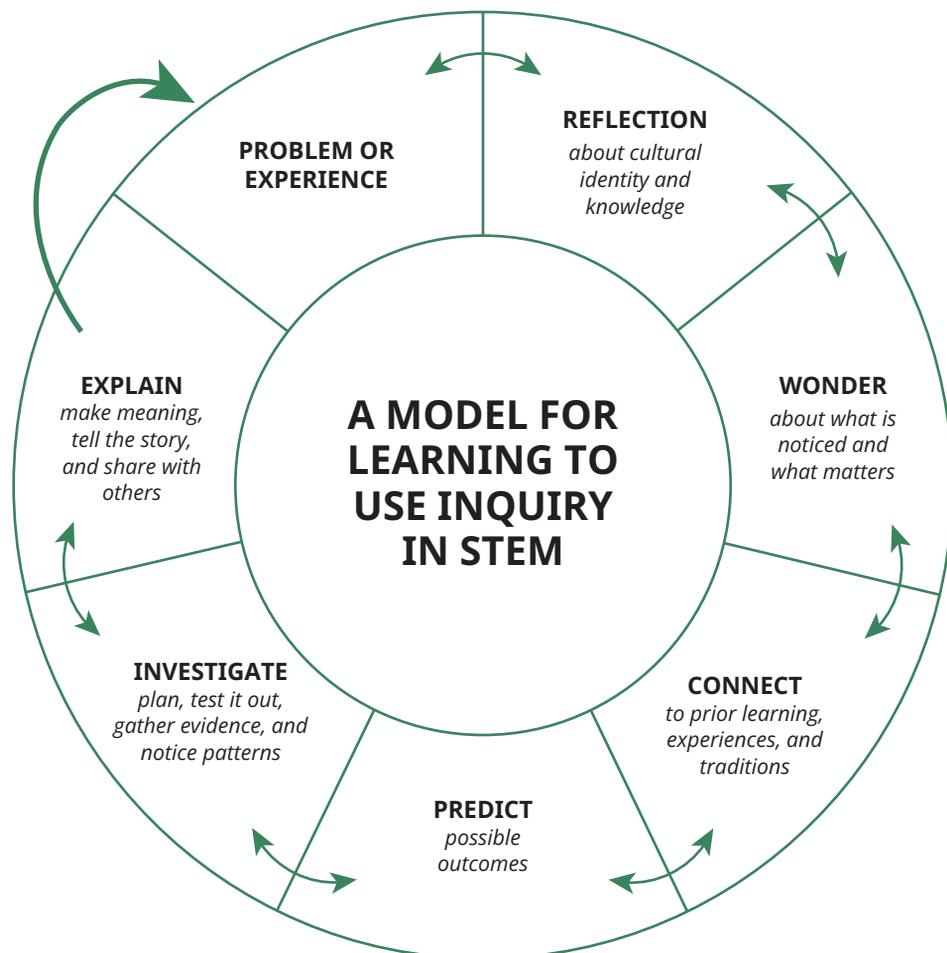


SOURCE: istock.com/Kali9

Research confirms these benefits. Inquiry-based STEM investigations promote reasoning, communication, and early literacy skills. Exploration and experimentation build curiosity and flexible thinking. As seen in **Figure 1.2**, engaging learners in the inquiry process involves careful guidance from educators to help learners develop independence in reasoning through inquiry. Students can learn through play and problem-solving to help develop skills in creativity and collaboration that are both necessary for critical thinking in STEM education (McClure et al., 2017; National Research Council, 2012). These competencies align with the needs of a rapidly changing world.

Early STEM education also supports the development of cultural identity. Aside from seeing diverse scientists, engineers, and innovators represented in their learning, early learners benefit from engaging in descriptive

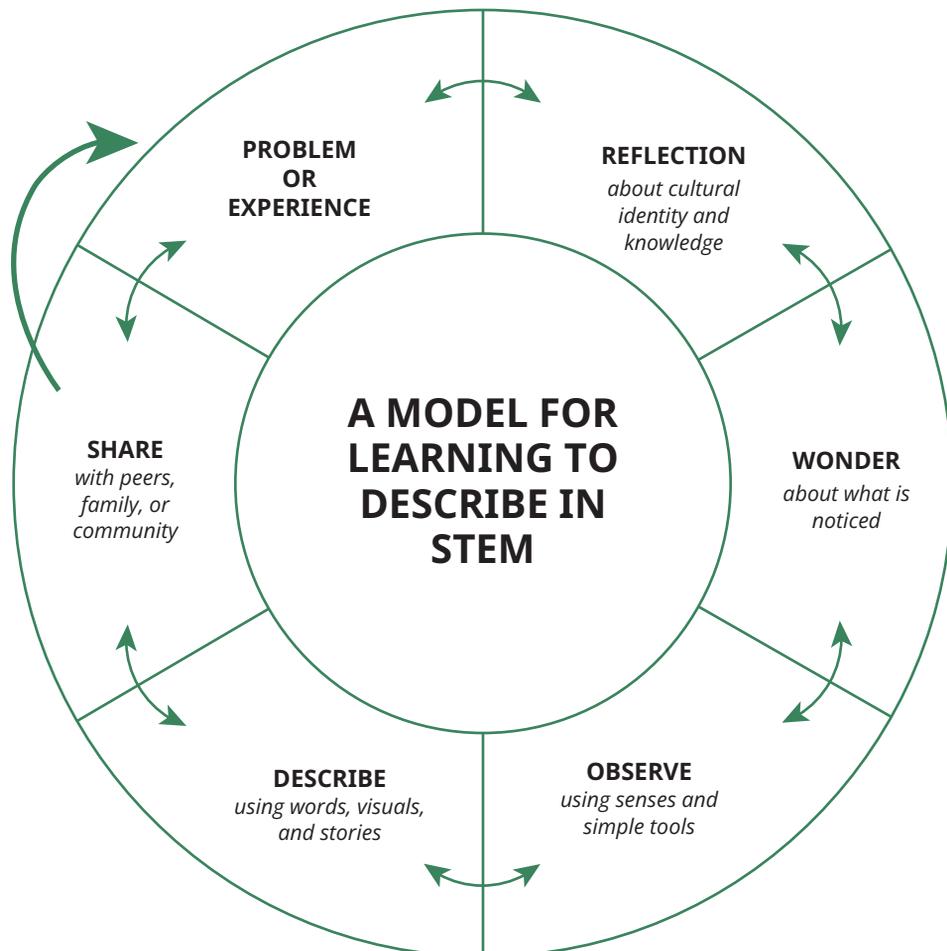
FIGURE 1.2 MODEL FOR LEARNING TO USE INQUIRY IN STEM



investigations as represented in **Figure 1.3**. Descriptive investigations provide opportunities for early learners to communicate using familiar cultural practices, such as storytelling, to describe what they observe happening in STEM spaces. Descriptive investigations build a bridge between the STEM classroom and a student’s home life by providing students with opportunities to use their cultural knowledge in ways that are familiar to them. When instruction reflects the home lives and family traditions of students, it builds a sense of recognition and belonging.

Likewise, teachers who integrate their own cultural identities into instruction model authenticity and invite students to do the same (Flake, 2023b). Teachers who understand their cultural identities and how those identities inform their practice are better equipped to create inclusive classrooms.

FIGURE 1.3 MODEL FOR LEARNING TO DESCRIBE IN STEM



These intentional shifts help students feel valued, capable, and connected to the content. As such, research indicates that students from underrepresented communities are more likely to persist in STEM fields and exhibit long-term academic motivation when their teachers reflect their identities and affirm their experiences (Berry & McClain, 2014; Flake & Lubin, 2024; Gutiérrez, 1995; Ireland et al., 2018).

As teachers, we are the gateway to creating these conditions. Inclusive instruction begins with our engagement in critical self-reflection. When educators explore how their cultural identities shape their teaching, they are more likely to build lessons that connect meaningfully with students and families (Flake, 2023a, 2023b). These practices promote equity by validating a student's way of knowing and making STEM content more relevant to them.

The following kindergarten science lesson shows how instruction can affirm identity in developmentally appropriate and culturally grounded ways:

CALL TO ACTION: SINK OR FLOAT?

Grade Level: Kindergarten

Focus: Physical Science, Counting and Cardinality, and Measurement and Data

Home Connection: Students bring a small, waterproof object from home that holds personal or cultural significance.

Suggested Standards Alignment

- Next Generation Science Standards: K-PS1-1; K-PS2-1; K-ESS3-3
- Common Core State Standards for Mathematics: K.CC.B.4; K.CC.B.5; K.MD.A.2; K.MD.4.3

Vocabulary

- Buoyancy
- Sink
- Surface
- Water

- **Engage:** Begin by inviting students to share experiences with floating and sinking. Frame the activity to learn from one another. Engage students in a read-aloud (i.e., *Who Sank the Boat?* by Pamela Allen).
- **Explore:** Students work in small groups to test their objects in water. They make predictions, sort the objects, make comparisons, and record their observations using drawings, writings, or a discussion as seen in Figure 1.4.
- **Explain:** Facilitate a class discussion using examples from students. Introduce vocabulary and encourage explanations in home language and everyday terms.
- **Elaborate:** Extend the lesson with cultural or historical examples. Discuss how different communities use floating and sinking objects. Invite family members to share personal stories.
- **Evaluate:** Reflect as a class. Ask students what they learned about their object. Encourage students to share why their object is useful for their community. (This list is based on the 5E Instructional Model; Bybee et al., 2006.)

FIGURE 1.4 STUDENT EXAMPLE

Object	Prediction		Test	Family Meaning
	buoyancy	sink		
Seashell	✓		sink	I found it on a family vacation.
 Boat	✓			This was a birthday gift from grandpa.
 Bracelet		✓	sink	This is a sister bracelet.
 woven basket		✓	buoyancy	My aunt made it for my dad.
Canicas (marbles) 		✓		I play games with my cousins.

Did you notice how the lesson affirms cultural knowledge while meeting grade-level science goals? Did you also see how the lesson illustrates how teachers can integrate identity work without abandoning academic rigor? These approaches

The cell body of a neuron contains the nucleus and organelles that are essential to the function of all cells (Purves et al., 2001).

A neuron is a nerve cell that includes a cell body, an axon, and dendrites. Neurons transmit messages (Geisen & Pearce, 2019).

A dendrite is the part of the neuron that receives signals from other neurons (Geisen & Pearce, 2019).

The axon is the part of the neuron that carries signals away from the cell body (Geisen & Pearce, 2019).

The myelin sheath covers the axon and helps the messages travel faster.

The axon terminal passes information to the next neuron (Purves et al., 2001).

build a foundation for learning and help students develop confidence in their ability to participate in STEM.

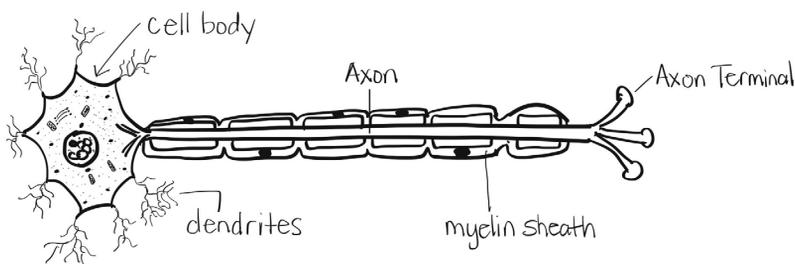
Understanding the Brain and Its Connection to Identity

Ongoing research in neuroscience highlights a strong connection between psychological safety, brain development, and learning. The brain contains about 86 billion neurons, most of which are present at birth. These neurons communicate across life and form nearly 150 trillion connections. Each time a person learns, new connections form or existing ones strengthen, which shows why active and ongoing learning during childhood is critical for early brain development (Candela-Leal et al., 2025; Goldberg, 2022; Purves et al., 2001).

Figure 1.5 shows the main parts of a neuron:

- The cell body is the center of the neuron.
 - A dendrite branches out to receive messages.
 - The axon carries messages away from the cell body.
- The myelin sheath helps those messages travel faster.
 - The axon terminal passes the message to the next neuron.

FIGURE 1.5 NEURON



Between ages 5 and 10, a child's brain is especially open to growth. A child who feels recognized and safe in the classroom forms brain pathways

associated with knowledge, a sense of belonging, and confidence. A child who faces exclusion forms pathways connected to stress and avoidance, which weakens learning and damages their sense of cultural identity in STEM (Flake, 2023b; Harlen, 2015; Purves et al., 2001).

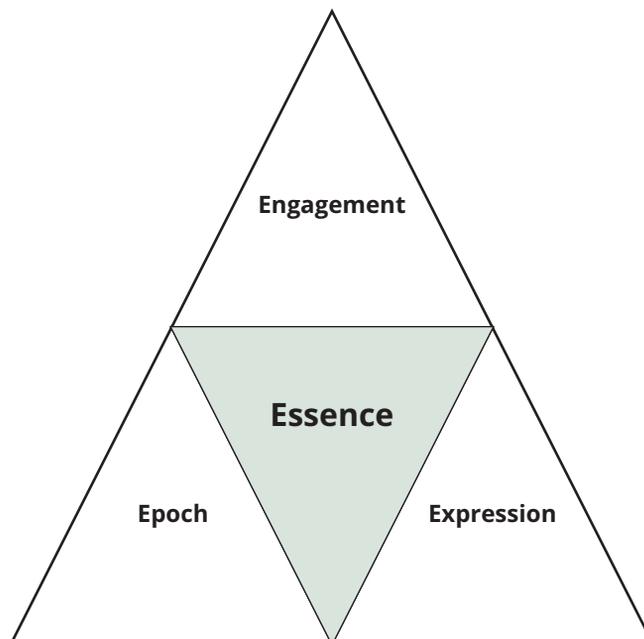
Learning involves both cognition and emotion. Because stress hormones affect brain growth, not all stress has the same impact on the brain. Constructive stress, which involves solving a new problem, can spark growth. On the other hand, harmful stress, such as failure or a curriculum that erases a child’s cultural identity, blocks learning and is damaging to the brain (Harlen, 2015; Shonkoff et al., 2009).

The need for early STEM exposure in a cultural identity affirming space is why inclusion and access matter (Flake, 2023b; Handelsman & Smith, 2016). When teachers create classrooms that welcome each student’s cultural identity by providing access to inquiry, problem solving, and exploration through culturally affirming practices, they support both strong brain development and psychological safety and well-being in STEM. Alternatively, children who are denied access to meaningful STEM instruction or face gatekeeping practices lose opportunities to shape their brains in ways that prepare them for the future. Culturally inclusive teaching in STEM is crucial for supporting the brain development of early learners (Tierney & Nelson, 2009).

THE FOUR DIMENSIONS OF CULTURAL IDENTITY

To support this transformation, this book introduces the Four Dimensions of Cultural Identity.

FIGURE 1.6 FOUR DIMENSIONS OF CULTURAL IDENTITY



The Four Dimensions of Cultural Identity (**Figure 1.6**) is a research-based framework that helps explain the multiple, interconnected aspects of an individual's cultural identity (Flake, 2023a, 2023b; Flake & Lubin, 2024). It includes four distinct dimensions—Essence, Engagement, Expression, and Epoch—that offer language and structure for describing how identity shapes experience. The following section introduces each dimension.

Essence represents the core of identity. It includes one's race, ethnicity, gender, and nationality, which are characteristics that shape how we navigate the world. These are often the most visible aspects of identity, yet they are also deeply personal and inform how we perceive ourselves in relation to others. Embracing the essence of one's cultural identity as a STEM educator means acknowledging how our core identities influence the ways we teach, learn, and connect with students.

Engagement reflects how we connect with others and build relationships, whether with students, colleagues, or our broader communities. Teaching requires interaction, mentorship, and collaboration. Lived experiences, cultural norms, and social expectations influence the way educators engage with their students. Likewise, the way our students engage with one another is shaped by how we, as teachers, model the social norms we have learned. Therefore, it is valuable for STEM educators to recognize their engagement cultural identities, the ways in which the assets of their engagement cultural identities contribute to creating thriving communities, and how their engagement cultural identities position them to enact change within STEM.

Expression is the outward display of identity, encompassing language, traditions, artistic contributions, and pedagogical approaches. In the classroom, expression may manifest in the ways teachers structure their lessons, the cultural examples they integrate into their curriculum, or even in how they encourage students to bring their full identities into learning spaces. Expression is a reminder that identity is something to be celebrated and woven into the fabric of education.

Epoch is the fourth dimension of cultural identity. It connects the individual to their ancestral history and legacy. Epoch cultural identity highlights the historical experiences and generational influences passed down from our ancestors that shape our present being and experiences. Every educator carries the weight of their past, whether through the legacies of those who came before them or through the historical narratives that have shaped their communities. Understanding the role of epoch cultural identity allows educators to see themselves as part of a larger continuum, ensuring that the knowledge and resilience of their ancestors and communities inform their teaching practices.

Each of these dimensions plays a crucial role in helping STEM educators cultivate **Identity–Belonging–Agency (IBA)** (Flake, 2023b; Flake & Lubin, 2024), which is an essential element building communities and fostering inclusive teaching practices (Flake, 2023a, 2023b; Flake & Lubin, 2024). IBA provides a lens through which educators can assess their journeys, the environments they create for their students, and their agency for reshaping the STEM community.

Engaging With IBA

The first step in this process is engaging with the research and theoretical foundations that highlight the importance of cultural identity in STEM education. Understanding the historical and systemic barriers that have shaped the field of STEM helps educators see the necessity of integrating identity-affirming practices into their teaching. This knowledge serves as a foundation for reflection. It offers insight into why the current structures exist and what we can do to transform them.

Critical reflection is central to this journey. Throughout this book, we will use the Four Dimensions of Cultural Identity Journal Prompts, which are designed as critical reflection prompts to help unpack cultural identities. These reflective moments will enable readers to critically examine their identities through their lived experiences, question their assumptions, acknowledge the strengths they bring to their STEM classrooms, and develop plans for transformation. Critical reflection is necessary for growth, while people often described it as being uncomfortable. By engaging in the process of critical self-reflection about cultural identity, educators are prepared to actively challenge and disrupt the systemic narratives that have long dictated who belongs in STEM.

Because reflection alone is insufficient, this book offers opportunities for readers to take action. Guided strategies will help readers bridge the gap between self-awareness and practice by translating critical reflections into meaningful classroom experiences. Each opportunity offers tools for designing culturally relevant and affirming STEM lessons to help students see themselves reflected in STEM as they engage with the content. Therefore, the goal is to empower each reader to use their critical reflections about their cultural identities to transform their teaching and create environments where all students, especially those from historically marginalized backgrounds, feel seen, valued, and empowered.

Understanding and embracing the Four Dimensions of Cultural Identity is key to reimagining STEM education as a more inclusive and affirming space.

Identity–Belonging–Agency (IBA) is an approach to transforming STEM education through culturally grounded teacher practices. It centers multidimensional cultural identity as a catalyst for building thriving communities and leads to liberatory change. IBA supports critical self-reflection, instructional planning, and student engagement by affirming who educators are, cultivating spaces of belonging, and activating the agency needed to change exclusionary norms in STEM (Flake, 2023b; Flake & Lubin, 2023).

Each dimension offers a platform for educators to recognize and leverage the assets of their cultural identities in the classroom. Note that this chapter introduces the Four Dimensions of Cultural Identity. I will go into greater depth exploring each dimension beginning with Chapter 2.

APPLYING THE COMPANION JOURNAL FOR GROWTH

As previously mentioned, an online companion tool, *The Four Dimensions of Cultural Identity Journal*, is available to support our journey of critical self-reflection and transformation about who we are in STEM education. Throughout this book, readings will direct us to journal prompts that align with the content. The journal is intentionally structured to guide us through individual critical self-reflection, deepening our understanding of self, belonging, and agency through a carefully sequenced set of reflections. I purposefully developed each prompt to align with the Four Dimensions of Cultural Identity and IBA. My intention in providing the prompts is to guide readers in exploring and affirming their multidimensional cultural identities as they navigate their role in STEM education.

COMPANION JOURNAL

<https://qrs.ly/mih0mp6>



To read a QR code, you must have a smartphone or tablet with a camera. We recommend that you download a QR code reader app that is made specifically for your phone or tablet brand.

The journal follows a structured pathway, moving from self-exploration to community connections and, ultimately, to liberatory action in Chapter 7. First, we will deeply examine the layers of cultural identity and how it shapes our experiences. As we progress, we will reflect on the communities where we thrive and where our assets are valued. The final section of the journal challenges us to take action toward liberating the field of STEM.

Before continuing to read this book, consider taking a moment to become familiar with the format by reading the front matter of the Cultural Identity Companion Journal. Next, we can begin to ground ourselves by thinking about our cultural identities. Let's use Journal 1.1 to acknowledge our various cultural identities.

JOURNAL 1.1

Identifying Your Cultural Identities



- ▶ Start by taking a moment to think deeply about who you are. Make a list of all your identities. This critical reflection is about naming and acknowledging the multidimensional cultural identities that comprise your whole self.

WHAT'S NEXT? PREPARING FOR THE JOURNEY AHEAD

As we prepare to add brilliance to the STEM narrative, let's begin by gathering our state standards and district curriculum guides. We can start to identify units, themes, and learning goals where there may be opportunities to integrate cultural identity into instruction. Highlight chances to include the lived experiences of our students. Consider reviewing the curriculum with a colleague or instructional coach and initiate a conversation about where cultural identity, belonging, and agency are already present, as well as opportunities to become more inclusive. Use Journal 1.1 as a reference throughout this process. By examining what we teach in conjunction with who we are, we can create a foundation for transforming our classrooms into spaces of righteousness and affirmation.

CHAPTER SUMMARY

- Cultural identity is a strength, instead of a barrier.
- The Four Dimensions of Cultural Identity offer a process for unpacking cultural identity.
- IBA supports transformative teaching and dismantles illusions of hierarchy in STEM education.
- Embracing cultural diversity and creating spaces for multidimensional cultural identities is essential to transforming STEM and diminishing the idea that STEM is neutral.

REFLECTION QUESTIONS

1. What are our goals for exploring the Four Dimensions of Cultural Identity?
2. How do our current teaching practices reflect or neglect aspects of identity, belonging, and agency?
3. What are some initial thoughts about using IBA to design STEM learning that are culturally affirming and inclusive?

