Creating a Reggio-Inspired STEM Environment for Young Children



Vicki Carper Bartolini

4. The Use of Space

5. Aesthetics

- 6. Materials and Themes
- 7. The Teacher's Role
- Resources for Setting Up a Reggio-Inspired STEM Environment

Messages and Values in the STEM Environment

<sup>3.</sup> The Use of Time

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Vicki Carper Bartolini



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To my curious and adventurous granddaughter Rosie (see the cover photo thanks to her mom, Anna) and to all young children everywhere who deserve wondrous, playful learning experiences.

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### INTRODUCTION: LESSONS LEARNED FROM A PRESCHOOL TEACHER

We are living in a critical era in the evolution of early childhood education. We stand at the nexus of multiple areas of focus: the significant number of children in the United States spending literally years in early childhood education and care; the inequities in the accessibility, affordability, and quality of care in the programs children attend; the professional stresses facing early childhood educators; and the importance of creating high-quality playful learning environments for children. And in 2021, with the world in pandemic and the United States reckoning with systemic racism, these challenges felt ever more present.

Several streams of my long and treasured teaching career, working with both children and adults, flowed together to form my ever-evolving philosophy and ultimately led to the writing of this book. Earlier in my career, in my role as an elementary and special education teacher, I was committed to working with children who were challenged in one way or another, from complicated home lives to learning differences. Then in my role as an early childhood coordinator for a public school system, I became familiar with the challenges of working within what is often referred to as a "mixed delivery system" of early education and care (Marshall et al. 2005, 1)—that is, working with public, private, family child care, Head Start, early intervention, and school-age programs. Moving subsequently into higher education teacher preparation, both at the undergraduate and graduate levels, I worked with many future as well as experienced teachers all across New England.

During my time in higher education, I had the amazing opportunity to study multiple times in Reggio Emilia in northern Italy, internationally recognized for their exceptional early childhood programs. While there, I became enthralled with many aspects of their philosophy. I deeply admire not only their respect for the competencies of children, but also their regard for the intellectually stimulating work of early childhood educators. I observed that many of their famed child-centered projects integrated STEM experiences. For example, I attended a presentation documenting children's inquiry and research into how to create a rainbow. Other well-known projects include children's study of birds and the construction of an amusement park for the birds. I was particularly inspired by their appreciation for the importance of the learning environment and their conception of the environment as "the third teacher" in the classroom.

Afterward, combining my interests in providing high-quality early education and care for all children, learning through play, early STEM literacy, and the Reggio Emilia philosophy, I began video documentation projects of young children as they developed early STEM understandings through play across a variety of settings. Ultimately, this STEM focus led to a publication in *Innovations in Early Education: The International Reggio Emilia Exchange*, national and international conference presentations, and my commitment not only to teaching but to advocacy and policy work on behalf of all young children and early childhood educators.

During our current turbulent times, these priorities still drive my work. Although, as I am writing this, we do not yet know what a post-COVID preschool education will look like, we as a society are beginning to recognize more than ever the essential role of early education not only to the benefit of our children but also to the viability of our economy. Additionally, we are in desperate need of learners who value inquiry and STEM, ultimately becoming STEM-literate citizens and, in some cases, STEM professionals. We must resolve to make access to high-quality early education and care equitable for all children, including Black children, Indigenous children, and children of color who are often left behind in our patched-together mixed delivery system of early education and care. Regardless of socioeconomic status, gender, race, ethnicity, disability, religion, or first language, all children deserve opportunities to develop their competencies. All children deserve programs staffed with caring and well-prepared educators. All children deserve stimulating learning environments where inquiry through play is valued. Subsequently, as a society, we are starting to better appreciate the essential work of well-prepared early educators and the importance of high-quality early education and care.

As policy makers and administrators push STEM education more and more, increased support for teachers' professional development is essential. Thus, this book was born out of years of experience with children, teachers, administrators, and policy makers and the pressing need to provide high-quality early STEM learning environments for all children. For several years, I taught a course to preschool teachers interested in integrating STEM into their settings. I met "Marie," a preschool teacher who intrigued (and initially frustrated) me with her attitude toward my course, Teaching Preschool STEM. To learn more about the teachers, I asked them their goals for the course. Whereas some talked about wanting to understand inquiry more deeply, gain familiarity with new state standards, or learn more about the Reggio Emilia schools, Marie told me she "just" wanted to know what materials she should have in her classroom environment. At the time, I thought that together the other students and I could answer her question during the first session. I was puzzled that this was "all" she wanted out of the course, given that her center seemed to be well resourced.

What I soon realized was how important her question was to my understanding of these teachers' needs and how honest and brave Marie was for asking this question. The teachers' needs were abundant, including

- understanding inquiry and the scientific processes involved in STEM,
- developing content knowledge of topics,
- identifying and accessing appropriate professional resources,
- implementing prescribed activities while supporting learning through guided play,
- building background knowledge,
- preparing to teach in new ways,
- and perhaps most importantly, finding professional time and garnering administrative support to accomplish these goals.

This was an aha moment for me in how to better collaborate with preschool teachers to meet their practical and urgent needs. After all, they were working while at the same time trying to strengthen their own STEM background knowledge, acquire necessary materials, set up their learning environments, and teach the wonder of STEM playfully and effectively to young children—a tall order indeed! These are the same preschool teachers whom our society has come to rely on to support our workforce, yet these "essential workers" are typically overworked, underpaid, and devalued.

Ultimately, Marie's efforts, and those of her colleagues in the class, far surpassed my expectations. Their projects showcased young children's studies of sound, states of matter, shadows and light, construction/design of buildings, and gardening, as well as documentation of teachers' developing questioning skills. Teachers reported making changes to their preschool environment, including more inquiry-based learning and less prescriptive teaching. Others shared how they were using the outdoors as a classroom, not just a playground, or how they were stretching more focused studies over days and weeks, rather than squeezing in fifteen- to twenty-minute STEM activities. Others shared strategies they used to advocate for support from directors and communicate their efforts to families.

Through my experience with Marie and interactions with thousands of other preschool teachers, I've come to the conclusion that *Creating a Reggio-Inspired STEM Environment for Young Children* needs to focus on these key practical yet philosophical issues:

- messages and values in the early childhood STEM setting
- use of time, use of space, aesthetics, materials
- the teacher's role

Use of these elements also promotes the 6Cs as described by Roberta Golinkoff and Kathy Hirsh-Pasek in their book *Becoming Brilliant* (2016): collaboration, communication, content, critical thinking, creative innovation, and confidence. These authors agree that the "Reggio way" encourages the greatest joy, satisfaction, and intellectual engagement for both the child and the teacher. My hope is that starting small, one step at a time, readers will begin to reimagine a playful and inquiry-based STEM learning environment, welcoming of all children, that is inviting, magical, and full of wonder.

#### How to Use This Book

Readers will find that each chapter focuses on one element to consider in designing a playful, inquiry-based preschool STEM learning environment. Chapter 1, "Lessons Learned from Reggio Emilia," highlights tenets of the Reggio Emilia philosophy that have profoundly impacted my work with preschool teachers. Chapter 2 focuses on messages and values in the STEM environment. Readers consider how their expertise in setting up the prereading environment reveals their values to children and families. They then will compare the messages and values expressed in their prereading environment to those conveyed in their STEM learning environment.

Chapters 3 and 4 focus on the flexible use of space and time to promote and sustain STEM studies, often lacking in US preschool settings. Chapter 5, "Aesthetics," encourages the reader to contemplate the importance of beauty, order, and natural elements. In chapter 6, "Materials and Themes," I share a sampling of STEM studies and corresponding materials to have on hand. "The Teacher's Role in the STEM-Centered Learning Environment," chapter 7, encourages the reader to consider what is referred to as the "pedagogy of listening" in Reggio centers, as well as other aspects of teachers' knowledge and skills. Finally, the book ends with a sampling of exemplary resources that preschool teachers and I have found beneficial in designing the STEM learning environment.

A practical feature included in each chapter is a **Self-Assessment Checklist** to help the reader decide on **One Thing to Try Tomorrow**. Each chapter closes with **Snapshots** of three different preschools—each with varying degrees of flexibility, finances, and support—in their ongoing journeys to address challenges big and small in their STEM learning environments. The Elisabeth Amen Nursery School on the Wheaton College campus, a Head Start program local to the author, and the Anchorage Park Kindergarten in Auckland, Aotearoa New Zealand,

provide snapshots of evolving STEM learning environments influenced by the Reggio Emilia philosophy. The Elisabeth Amen Nursery School finds that its journey has primarily focused on creating an outdoor classroom. The Head Start program works to balance prescribed curriculum with more playful, inquiry-based STEM studies. And the Anchorage Park Kindergarten continues its efforts to create a magical environment that is respectful of all children's competencies.

Throughout, the book emphasizes the importance of including *all* children in the STEM learning environment, regardless of gender, race, ethnicity, religion, first language, disability, or socioeconomic status. Additionally, it is our responsibility as teachers to model respect for our planet by using low-cost (or no-cost) recycled and repurposed materials. It is also our obligation to nurture children's appreciation and responsibility for the natural world of which we are all a part.

And, finally, when reading this book, and always: be patient with yourself. Change takes time. Start small with a baby step, test it out, and see what works and doesn't work for your setting. Find others to work with, laugh with, and wonder with!

### CHAPTER 1: LESSONS LEARNED FROM REGGIO EMILIA

And our expectations of the child must be very flexible and varied. We must be able to be amazed and to enjoy, like the children often do. We must be able to catch the ball that the children throw us, and toss it back to them in a way that makes the children want to continue the game with us, developing, perhaps, other games as we go along.

-Tiziana Filippini, pedagogista and former director of the Documentation and Research Centre, Reggio Emilia, quoted in *The Hundred Languages of Children*, 3rd ed.

As with thousands of others who have been inspired by the Reggio philosophy, my thinking about the environment, particularly as it relates to STEM learning, transformed all of my professional work. I was surprised to notice how many of the Reggio investigations I observed or read about involve inquiry-based STEM learning. Whether children are studying the architecture of the buildings in their city or the mechanics of the curtains in a theater, they are consistently engaged in the 6Cs while conducting observations, collecting data, making predictions, and analyzing and evaluating data. Capturing children's questions, assumptions, collaborations, misunderstandings, communications, revisions, findings, joy, and wonder as they experimented with the properties of water, gears and mechanical devices, and the chemical processes of cooking reinforced my thinking about children's competencies and the importance of access to high-quality, playful learning experiences.

All children deserve wondrous, stimulating, and creative STEM learning environments where their amazements, curiosities, questions, and observations are valued. At the same time, all teachers deserve the opportunity and support to create such learning environments, ones that are inspiring and inviting to them as well. What I call "the Reggio way" provides a road

map as to how this might be done, with emphasis on finding one thing to try tomorrow using everyday, low-cost (or no-cost), thoughtfully chosen materials. Throughout this book, I focus on the following elements that are central to my understanding of the Reggio philosophy:

## 1. Teachers in Reggio Emilia describe the classroom environment as the "third teacher."

Typically preschool classrooms are staffed by two adults who scaffold and facilitate learning. In these early childhood Reggio centers, the environment is considered the third teacher, the laboratory where learning is supported and constructed. The intentional design of this environment fosters encounters, relationships, communication, and collaboration among children and adults. Provocations such as puzzling objects or items from nature spur surprise, wonder, curiosity, discussion, and further study. Children's questions and interests evolve into investigations alongside their teachers. In this instructional and flexible space, studies unfold over time. Natural light, the color palette, and the careful selection and placement of materials create an inspiring instructional environment. Panels of children's work reflect respect and trust in children's competencies. The reader will find further discussion of the messages and values embedded in the environment (chapter 2), the use of time (chapter 3), the use of space (chapter 4), aesthetics (chapter 5), and the choice of materials (chapter 6).

# 2. Teachers in Reggio often describe their work with children as *inquiry* or *research*.

Practicing a "pedagogy of listening" prompted by children's questions and interests, teachers collaboratively engage in investigations using scientific processes, or the inquiry method— what some in the United States call *project-based learning*. Together they make observations, gather information, analyze the data, propose solutions, and reflect on their new learning. Viewing the children as competent and capable, full of intelligence, the teachers trust that children can sustain their engagement with complex, child-generated topics over a period of time. Children collaborate to research a topic or problem of interest, coming up with their own ideas. Along the way, while listening to children, teachers provoke further curiosity and critical thinking by asking open-ended questions. Together teachers and children document the learning process and outcomes of their investigations, capturing aha moments for reflection and celebration (chapter 7). Some examples of inquiry-based or project-based learning include planting and tending a garden, cooking with vegetables and fruits, composting with worms, and observing and recording life cycles of plants and animals.

# 3. In creating a Reggio-inspired learning environment, teachers promote the 6Cs.

As described in *Becoming Brilliant* by Roberta Golinkoff and Kathy Hirsh-Pasek (2016), the 6Cs are collaboration, communication, content, critical thinking, creativity, and confidence. As the authors note, "In many ways, the Reggio approach to learning is a perfect example of the 6Cs at work in a school environment. Like the 6Cs, it was born from the science that views children not just as heads but as whole, active engaged people with social sides too" (264). In the Reggio-inspired environment, children collaborate and communicate as they plan a project that provides for the study of rich content. Using their creative and critical-thinking skills—observing, comparing and contrasting, predicting, analyzing, reflecting—they investigate their topic. Despite probable bumps and disagreements along the way, they build self-confidence, trust, and respect for one another as they satisfactorily document, complete, and share their investigation or project.

#### 4. Teachers lead by example.

Throughout this book, I have sprinkled my beliefs about how important it is that we inspire children to marvel at, value, and care for the sacred web of life. Reggio educators strive to bring the outdoors in and the indoors out, understanding the learning opportunities found in nature. This commitment continues with their responsible and innovative use of the Remida, the Creative Recycling Centre. Here industries donate unused or scrap materials that teachers recycle and repurpose.

#### Self-Assessment Checklist

- What is the philosophy of your setting? Classroom? Preschool? Do you have a philosophy? How might the Reggio elements discussed in this book and the 6Cs connect with you or help you develop and make visible a living, breathing philosophy?
- What resources do you already have that you can build upon? What interesting materials might be available? Perhaps you have access to a safe neighborhood for outdoor adventures. Are you within walking distance of a park, library, museum, factory, pond, shady trees, or open field? Do you have parents, colleagues, or friends who might be willing to share their hobbies or expertise in STEM areas?

• Using guidelines from Susan Stacey's book *Inquiry-Based Early Learning Environments*, "examine old scripts of 'what should be' in an early childhood environment" (2019, 14). She defines scripts as "long-held ways of doing things" that may have lost meaning or value in your setting. As you read, consider new scripts that can support your evolving philosophy as it pertains to the STEM early learning environment.

#### **Snapshot: Elisabeth Amen Nursery School**

The historic Elisabeth Amen Nursery School, situated on the campus of Wheaton College in Norton, Massachusetts, provides a private full and part-day preschool program. It serves as a lab for the psychology department and field placement site for the education department. Following a study trip with me to Reggio Emilia, the former director of the nursery school returned to this campus lab school questioning the "old scripts" and the messages and values promoted in the environment of their early childhood program. Her questioning was the start to many changes in the nursery school, continuing today with a passionate new director (a teacher who worked with the former director). For example, the entrance hallway (or what in Reggio would be considered a kind of piazza) is now valued as a place of intersection and social exchange for passing teachers, staff, children, parents, and college students who work at the nursery school. Documentation of the children's investigations is showcased, promoting public discussion as passersby notice, question, interpret, and admire children's work.

As the new director proudly notes, their entrance to the school conveys "respect for the child" and "the wonder of it all," very much in keeping with the Reggio philosophy as well as with the 6Cs. However, as she notes, "Change is a process that takes time. It involves staff buy-in, figuring out things together, being afraid yet still taking risks, testing and revisiting, and of course finding resources." They have found that establishing some long-term goals while working on one shortterm objective at a time helps them to maintain balance and perspective. Since 2014, their overarching long-term goal has been to transform their traditional playground into a playful outdoor, inquiry-based classroom, while also working to integrate the arts with inquiry-based learning (what some might call STEAM science, technology, engineering, arts, and mathematics). Short-term objectives allow the parent advisory committee, in place for a two-year commitment, to focus their energies on a specific project while working toward the overarching long-term goal. Objectives have included purchasing a four-sided outdoor easel and providing a cover for the outside stage for children's presentations. Working together on the outdoor classroom has forged a great partnership among families, local volunteers, and the staff. Snapshots of the Amen Nursery School throughout this book primarily focus on the ongoing development of their outdoor STEM learning environment.

#### **Snapshot: Local Head Start Program**

At the local Head Start, the director noted that STEM is now everywhere in the environment. Opportunities for hands-on exploration can be found all around the setting, including bookcases, shelves, the dramatic play area, in displays of children's books, and outdoors. Teachers have made STEM tools such as scales, magnifying glasses, large magnets, blocks, and tweezers readily accessible for hands-on explorations. Children's observations of life cycles are at eye level, encouraging questions, discussion, data analysis, and conclusions.



Comprehensive in its offerings, this part-day federally funded preschool program includes education, nutrition, medical, family support, transportation, and home visiting components. Children come from many backgrounds, often from families whose first language is not English. Entry into the program is based on income criteria. As a federal program, they must follow extensive regulations, including use of the required Creative Curriculum. A few years ago, Head Start programs began to emphasize the integration of STEM studies and experiences for children. Although the local Head Start program did not intentionally design their current program based on knowledge of the Reggio Emilia philosophy, they have found that, over time, they are uncovering and embracing many Reggio elements as they work to implement their curricular guidelines.

A few years ago, working with Wheaton College students, the director began a weekly STEM Day. College students planned and implemented the weekly activities. The director now describes STEM as having become more integrated, in "little ways" throughout each day, with the teachers and children no longer seeing "today" as STEM Day. She describes the teachers as becoming more excited and finding the integration of STEM "not that hard." In fact, she describes the children as often leading the teachers—evidence of teachers listening to children and coresearching with them, principle elements of a Reggio approach, as when teachers and children investigated prisms, light, and rainbows together. And in true Reggio style, at the end of many blocks of study, a community celebration with children, families, and teachers takes place.



#### **Snapshot: Anchorage Park Kindergarten**

The Anchorage Park Kindergarten staff fosters an "engaging magical environment" where the environment is the third teacher. Children move seamlessly from the outdoors to the indoors, exploring with wonder and curiosity while engaging in the 6Cs.

This award-winning, publicly funded kindergarten serves preschool children and their families in a suburban area of Auckland in both full- and part-day programs. Following Te Whāriki, the Aotearoa New Zealand early childhood education curriculum that reflects both English and Maori cultures, the center also meets the policies of the local kindergarten association. However, as the head teacher explains, "Each kindergarten has its own philosophy, vision, and business plan allowing for their personal beliefs about teaching and learning, social competencies, culture, and community to shine." Anchorage Park's process of change began in mid-2009, when making one small change using clay and art naturally evolved as the team began to ask, "How do we provide a magical space for children and change our environment to uphold our philosophy? How do we change to provoke children's thought processes? How do we ignite that spark? How does our environment meet children's needs? How do we balance all their needs?" These profound questions triggered the process to create an "engaging magical environment."

The head teacher visited four centers that reflect the Reggio Emilia philosophy, each one more amazing than the last. She contacted an expert to serve as their mentor during this change process. The mentor provoked their thinking, challenging them to succinctly explain the essence of their center's philosophy. Six months later, after much in-house dialogue, they were able to identify their philosophy in four powerful sentences. They found that change came "one little piece at a time" and that the process of change provoked strengths in the teaching team. "We learned to trust our team strengths, our thought processes and beliefs, and to stand tall," very much in keeping with the way Reggio educators see their work as democratically inspired and intellectually stimulating. Long-term sustainable goals, reflecting the needs of their fifty families and nineteen cultures, remain their priority to this day.

### CHAPTER 2: MESSAGES AND VALUES IN THE STEM ENVIRONMENT

The concept of the "environment as the third teacher" continues to be developed. . . . We have begun to realize that this concept is much more complex than any set of guidelines for appropriate equipment, materials, room arrangement, and display. It is tied to our image of the child; knowledge and ongoing study of any given group of children, teachers, and parents; our understanding of the concept of scaffolding; our use of documentation; and our ways of thinking about organization of time and relations among all members of the learning community.

-Brenda Fyfe in Reflections on the Reggio Emilia Approach

Many preschool teachers spend countless hours intentionally designing the optimal prereading/early literacy learning environment. For example, walking into my local Head Start program, parents and children are immediately greeted by children's names adorning cubbies and birthday charts. Carefully written labels in English and Spanish (and some-times additional languages) are strategically placed on furniture to encourage connections between print and objects. An inviting writing table is covered with recycled paper and envelopes, rubber stamps, fat and skinny markers, pencils and pens to foster purposeful "writing." A cozy reading corner is outfitted with carpet, fluffy pillows, and a rocking chair. Color-coded bins, intentionally developed and organized with great sophistication, contain picture books, theme-based books, fiction and nonfiction books, multicultural books, books on tape, and books in languages other than English. Nearby is a puppet theater with store-bought and handmade puppets for children to act out stories. Looking across the setting, families often see parents, grandparents, and student volunteers reading to children. They see the teacher recording children's words as they describe their paintings or block structures, or helping to

write birthday cards. The alphabet is displayed at children's eye level, and the easel holds an inviting big book. Parents notice special backpacks containing books that families are encouraged to take home and read aloud nightly. This is a small sample of the sophisticated knowledge base and pedagogical strategies teachers employ in designing and developing a stimulating early prereading environment.

This description also speaks volumes regarding the values and messages these Head Start educators choose to convey in their classroom learning environments. Through their intentional choices, parents and children perceive that prereading literacy is important, social, stimulating, inviting, and relaxing. There are multiple entry points. You can do it alone or with a friend. There isn't always a "right or wrong" way, and there are many opportunities to practice. Different cultures and family structures are respected through the choices of children's books. The 6Cs—communication, collaboration, content, creativity, critical thinking, and confidence—are promoted through the prereading opportunities in the environment.

#### **Messages and Values in the Preschool STEM Environment**

Preschool teachers in my Teaching Preschool STEM course reflect on what messages and values their environments convey about the importance of inquiry and early STEM learning. To kick-start this reflection, we begin where they feel most comfortable—brainstorming how they currently set up their learning environments to reinforce the importance of prereading skills. The list is typically exhaustive and confidently created as most preschool teachers are guite passionate and clear about their beliefs and knowledgeable when it comes to promoting the prereading environment. We then do a similar exercise in setting up an inquiry-based and playful STEM learning environment. This activity is usually more challenging as many teachers struggle to articulate the extent to which STEM learning is prioritized and integrated across their settings. Comparing and contrasting the two lists provokes further discussion about why the prereading list was easier to complete than the STEM environment list. This analysis and reflection leads many educators to aha moments: most likely, given their difficulty with the exercise, they are not broadcasting an intentional message about the importance of STEM for families or children, often reflecting the teacher's lack of confidence and expertise in STEM content (as opposed to prereading) or an ill-defined philosophy about the importance of early STEM literacy.

#### **Reimagining the STEM Learning Environment**

As our class discusses this further, we begin to imagine a STEM learning environment that employs Reggio principles and the 6Cs, contrasting this with what these preschool teachers typically offer in the setup of STEM environments. For example, in an environment that conveys the importance of inquiry-based STEM learning, children work together in playful investigations, conveying the importance of the social aspects of STEM (communication, collaboration, and so on). Perhaps children are excitedly sharing binoculars as they begin a study of birds perching at bird feeders. Observing and discussing the variety of colors and sizes of birds outside the window, they document what they see, using drawings, sculptures, photos, or videos. They explore books and videos to identify the birds, capturing their data on a chart. In contrast, teachers in the course acknowledge that instead of promoting and providing flexible time for children's inquiry, they more often place a salvaged bird's nest on the windowsill alongside some bird books and a poster of different kinds of birds, hoping the children notice.

In our imagined STEM learning environment, documentation panels of children's STEM studies are visible, allowing children and families to revisit, reflect, and celebrate their learning. For example, panels of photos capture the children's building projects, including a study of tools and simple machines. However, teachers admit that they rarely preserve lasting evidence of STEM activities or investigations to showcase children's learning. Instead of responding to the children's interests and prodding their critical thinking with open-ended questioning and co-researching answers alongside them, more often than not the teachers either provide the right answers, correct the wrong responses, or allow misconceptions to go unchallenged, especially if they lack confidence in their own STEM knowledge.

This exercise, comparing and contrasting an imagined STEM learning environment with the realities and challenges of many preschool environments, leads the class to plan how to thoughtfully integrate STEM across the curriculum and *intentionally* convey messages and values to children and families. Using course readings from my studies in Reggio Emilia, STEM video documentation from my own work in early childhood settings, discussion of the 6Cs, and the self-assessment checklists from this book, we spend much of the course reimagining the messages and values that teachers' STEM learning environments might intentionally convey.

Given their budding self-awareness, teachers commit to an ambitious, yet doable, plan for the duration of the course (and hopefully beyond). It's also my hope that you, too, as the reader of this book will find inspiration from their experiences that will impact your work. They agree to develop and articulate their STEM environment philosophy, considering influences from Reggio educators as well as the 6Cs. Using the Self-Assessment Checklist and One Thing to Try Tomorrow exercises, they identify and commit to tackling small changes within their settings. Finally, they plan to implement and document at least one longer-term STEM investigation, based on their children's questions and interests. Participants are encouraged to work together if at all possible to benefit from one another's perspectives and for mutual encouragement and support. At periodic check-ins, each participant brings documentation (notes on index cards, outlines, drawings, photos, samples of children's work, videos, and so on) to class to share evidence, celebrate success, and seek feedback on their ongoing efforts. This collaborative, Reggio-style professional development fosters reflection, problem solving, and, most importantly, celebration of progress.

Teachers consider several questions as starting points in developing their own philosophical perspectives:

- How important is STEM literacy? Do you believe STEM literacy is important to your own life as a teacher and citizen?
- Do you feel a responsibility for children to regularly engage in STEM learning? If so, do you model the dispositions of curiosity, wonder, surprise, bewilderment, and so on?
- Do you see all children as capable STEM learners?
- Is your setting accessible to those with adaptive equipment requirements?
- Are all genders, Indigenous children, and children of color encouraged and supported in your STEM play and investigations?
- Are labels for STEM items, books, and videos presented in multiple languages to support English learners?
- Do opportunities for investigations vary in complexity to accommodate a range of learning abilities?
- Do you see inquiry as central to children's STEM learning? Do you listen to children's questions and interests and ask open-ended questions?
- How are the 6Cs prioritized as central to STEM learning?
- Is guided play considered a learning opportunity?
- Do children always need to find the right answer?
- How can flexible space, indoors and out, as well as the flexible use of time support investigations?
- Does the setting promote curiosity and wonder?
- How can you model responsibility toward the natural environment for children?

Slowly and thoughtfully transitioning to a more inquiry-based STEM environment requires careful consideration and selection of materials (my student Marie's original question!). Are recycled and repurposed items valued and available? Is recycling promoted? Are natural materials (pebbles, leaves, shells, pine cones), simple machines (pulleys, levers, gears),

transportation items (trucks, cars, boats, planes, bikes), living items (plants, animals), loose parts (beads, buttons, screws, mirrors, odds and ends), ramps, balls, blocks, and tools (binoculars, funnels, tubes, tweezers) available and easily accessible?

Teachers also informally assess whether families, children, colleagues, and administrators notice their more intentional values and messages surrounding STEM learning. Parents might see children engaged in guided play or playful learning. In *A Mandate for Playful Learning in Preschool*, Hirsh-Pasek, Golinkoff, Berk, and Singer state, "Playful learning or guided play actively engages children in pleasurable and seemingly spontaneous activities that encourage academic exploration and learning. . . . With playful learning, children are not searching for one right answer or wandering freely about the classroom without supervision. Rather, the children feel free to explore while the teacher makes sure they encounter certain content" (2009, 54). These playful investigations might include creating an invention with loose parts, constructing props for a theatrical production, preparing a variety of snacks for a celebration, building with blocks to make the fastest delivery route for trucks traveling through the mountains, across the river, to the city, and so on. Parents might also see children engaging in the 6Cs just as real scientists and engineers do—conjecturing, disagreeing, challenging, negotiating, demonstrating, and sharing strategies while grappling with ambiguity, frustration, mistakes, and misconceptions.

Parents begin to notice that high-quality early STEM learning experiences involve collaborative and playful social interactions coupled with learning through trial and error or risk-taking. Through these social exchanges, children listen to and learn strategies from each other. Those with limited background experiences engage in problem solving alongside others with more varied experiences. Children learning to speak English play with their friends and, alongside them, learn new vocabulary. STEM is actively integrated throughout the setting, not passively isolated to a display on a shelf or windowsill. Graphs, charts, tables, and posters capture children's growing understanding of data collection and analysis. Teachers model the pedagogy of listening, respecting children's questions and interests while responding with open-ended questions. Living things and life cycles are observable both inside and out, while natural materials abound for careful observation, sorting, and admiring. The outdoors is viewed as another classroom where curiosity, respect, and care for the natural world are nurtured. The playful, magical, and wondrous STEM learning environment, much like a prereading learning environment, not only recognizes the competencies of all children but also incorporates the essential elements of flexible time and space, aesthetic qualities, carefully chosen materials, and full realization of the environment's role as the third teacher.

As the teachers in my course work to design a more intentional, provocative, and stimulating STEM environment, we discuss the values and messages they hope to convey to children and families through their choices.

#### Self-Assessment Checklist

- Is STEM limited to a science center, table, windowsill, or shelf, or are STEM opportunities and materials integrated throughout my setting?
- Are children talking and working in groups, conducting experiments with such items as balls and ramps, lights and shadows, magnets, and so forth?
- Is there documentation or photos of groups of children engaged in collaborative inquiry about bubbles, plants, puddles, life cycles, and so forth?
- Are developmentally appropriate yet content-rich nonfiction books and photos about topics such as weather, life cycles, simple machines, transportation, counting, and so forth available for children's investigations and research?
- Are there plants (and realistic photos of plants) in various stages of development for observing, predicting, and recording in journals or with cameras? Are there terrariums for studying life cycles and the water cycle?
- Are there natural materials (pieces of wood, stones, shells, and so forth) and synthetic materials (beads, buttons, toy figures and cars, and so forth) available for organizing or tinkering?
- Are there charts and graphs posted to support children's investigations?
- Are there outdoor gardens for composting, planting, weeding, harvesting, and recording observations? (In limited spaces, mini-gardens can be planted in large pots or bins.) Are there bird feeders, binoculars, and bird books for observing and researching birds, as well as cameras, drawing paper, and markers for recording data?
- Are there opportunities for building structures outside or for playing in sand, water, and mud?
- Are there quiet, intimate, inviting places, both indoors and out, for collaboration, reflection, and relaxation while imaginatively playing with ideas?

- How do the messages in the environment convey respect for all of life and the importance of taking care of our planet? Do you reuse, repurpose, and recycle materials?
- How is technology used? Is it primarily used as a tool for researching topics of interest while actively involving children in the 6Cs?
- Are teachers listening to children's questions and comments while modeling the important dispositions of curiosity, wonder, skepticism, surprise, and so forth?
- Are all children involved and viewed as capable and competent, including those who need specialized equipment, navigable space, or attention to language development, and so forth? Are girls, Indigenous children, and children of color fully supported to participate and challenge themselves?

#### **One Thing to Try Tomorrow**

Consider inviting an enthusiastic colleague or mentor to join you—someone you respect and trust who is also interested in the STEM learning environment. Take out your phone or tablet and slowly pan your setting. Together, play back the video for reflection (and probably some laughter too). Without judgment, ask yourself and your colleague: What jumps out as the messages and values in your environment? What do you and your colleague notice regarding STEM? Do you see STEM as a priority that is well integrated across your setting? If your evolving philosophy about the importance of the STEM environment is not as apparent as you would like, review the Self-Assessment Checklist to determine a starting point for slowly transitioning into a more Reggio-inspired STEM environment that promotes playful and joyful learning. Give yourself a pat on the back for taking this small but important step!

#### **Snapshot: Elisabeth Amen Nursery School**



Focusing on the outdoor classroom, seasonal STEM investigations at the Amen Nursery School include walking through the apple orchard, apple picking, tasting, graphing, and cooking, as well as planning, planting, and tending the vegetable garden. Many opportunities arise for children to collaborate and communicate while they are involved in life science studies.

This preschool has long embraced a play-based curriculum. With reflection, ongoing study, and professional development, the staff worked to more clearly articulate and make visible to children, families, and the community their philosophy and values through the intentional choices they made in redesigning the environment. The Reggio principles of time, space, choice of materials, and outdoor learning, along with the importance of the 6Cs, were made more apparent. Changes to the outdoor environment show its central role in their emergent and project-based life sciences curriculum. Bird feeders, placed right outside the classroom windows, provide endless opportunities for observation and research. Seasonal STEM investigations include apple picking, tasting, graphing, and cooking, as well as planning, planting, and tending the vegetable garden. Learning about life cycles, children conduct a worm study, examine pond life, and explore what the children refer to as the "magical woods" on campus-a woodsy spot that is a little dark and mysterious and also full of surprising plant and animal life. Recently the staff, families, and Wheaton students collaborated on building an outdoor mud kitchen.

#### **Snapshot: Local Head Start Program**

As children, families, and visitors walk into this Head Start program after two years of ongoing change, messages about the importance of STEM in the early childhood environment are visible everywhere. Though each classroom is unique, the integrated nature of STEM is embedded in big and little ways throughout the center. For example, while one teacher is working with children on a roads and transportation study, another teacher and her children are conducting a tree study. The ongoing, complex study of roads and transportation entails block constructions spread out over a fairly large area with toy workers, signs, equipment, and various kinds of trucks. Children glue cutout paper triangles, circles, squares, and rectangles to create different kinds of trucks while also exploring shapes. Resources include posters, photographs, and children's books. Meanwhile, the tree study explores tree cookies, wood shavings, and bark in the water/sand table and includes walks to the nearby college campus nature trail to compare and contrast kinds of trees and to track changes in trees over time. Children's books focusing on STEM topics and tools such as binoculars, magnifying glasses, magnets, and balance scales are easily accessible throughout the classrooms. Though their studies are implemented as part of the required curriculum, extended investigations emerge from the teachers' or the children's questions and interests.

As the director notes, "The teachers place importance on the children's experiences." Valuing diverse perspectives, they allow children's questions to drive these extended investigations beyond the required curriculum when possible. Sharing her observations of their study about changing seasons, she noted that some children from countries outside the United States had never seen trees that change colors or felt snow, so the classroom teacher invited them to share about their familiar environments and ecosystems. This led to the class exploring what else, in addition to trees, might live and grow there. Contrasting and comparing in this way encourages children's critical thinking while building a collective body of knowledge. Children still learning English were explaining to their new friends (with help from the teacher and their peers) the differences between what the class observed and what the children might see if they visited their home countries. These discussions engaged the children in communicating with one another about their experiences with the rich content of living things (plants and animals) and seasonal variations (leaves changing and snow).

#### **Snapshot: Anchorage Park Kindergarten**



Creating small, intimate, and "private" spaces conveys the Anchorage Park Kindergarten's belief in the competencies of children to imagine, reflect, wonder, and communicate while relaxing alone or with others. Designing with interesting fabrics and patterns, sheer drapery, wind chimes, and books creates the inviting time and space for curious minds to ponder!

To ensure that the messages and values of their newly articulated philosophy were visible to the children, families, and staff, the Anchorage Park Kindergarten team spent a professional development week emptying out their center of all furniture and materials. They examined each item, asking themselves, "How does this reflect our philosophy? Is it needed? Does it reflect the inclusive, high-quality program that we envision? Does it contribute to an environment that nurtures social competence and a sense of belonging? Does it promote inquiry learning? Does it create small learning spaces for dialogue and interaction?" Some items were returned to the reimagined setting while others were donated to families or other programs. The Anchorage Park Kindergarten environment has evolved over the past several years into a school visited by others (including the author!) to learn about the opportunities that abound in such an inspiring, magical environment. It is virtually impossible to capture the wonder, the beauty, the provocations at every turn in this program. Surrounded by flowers, herbs, and vegetable plants, children cross a little wooden bridge into a mysterious, relaxing, intimate outdoor enclosure, complete with rugs, pillows, sheer coverings, chimes, more plants, and baskets of books. Following a raised wooden ramp walkway from this cozy, tucked-away haven, children wind through the towering plants into the outdoor loose-parts area. Here their imaginations run wild, leading to all kinds of innovations! As engineers, they design and construct contraptions of all sorts, using a small ladder, metal crank and pipes, large- and medium-sized wooden spools, lumber stored in different-sized clay pots, tires, and wooden pallets, all placed on rubber-matted flooring. Flowing easily between the outdoors and indoors, children explore seemingly endless STEM opportunities, ranging from designing and creating at the sewing table (with needles, thread, plastic straws, burlap, beads, and ribbon) to planning and constructing at the Frank Lloyd Wright architecture center (stocked with books about the architect, protractors, colored pencils, clipboards, and a variety of blocks) to exploring patterns with tinker tray collections of loose parts (from buttons and pebbles to feathers and tiny pine cones). And did I mention the large outdoor mud area where children experiment with bottles of colored water, stirring up soup with sets of measuring cups and cooking utensils or excavating a work site using their dump trucks, buckets, and shovels?

The center's messages and values are loud and clear to visitors: all children are competent and capable (and thus can learn to sew with teacher support or build safely with large tires), all children have the right to engage in inquiry (and thus can garden or experiment with mud), and all children have the right to explore and wonder in a magical environment. All children deserve opportunities to com-

municate their ideas and perspectives, collaborate with others as they make plans, critically think about the rich content around them, and develop their confidence in taking risks and solving problems in an environment that includes outdoor spaces and small intimate spaces. Or, as the head teacher says, "In corners, under, and behind, they explore with wonder!"



# Reimagine your environment with a focus on STEM using a Reggio Emilia lens

In Creating a Reggio-Inspired STEM Environment for Young Children award-winning educator Vicki Carper Bartolini offers practical suggestions and resources to re-envision your early learning environment with a focus on STEM. Using the Reggio Emilia lens that honors the right of children to have a wondrous learning environment, Carper Bartolini guides the reader to consider children's competencies as they collaboratively engage in STEM investigations.

Creating a Reggio-Inspired STEM Environment for Young Children inspires and gives you immediate steps to take in your own space. The book includes:

- Case studies of programs that have rethought their STEM environments
- Lessons learned from Reggio Emilia
- Guidance on use of time and space
- Materials and themes
- Resources for setting up a Reggio-Inspired STEM environment

Starting one step at a time you can re-imagine a playful, inquiry-based STEM learning environment that invites all children to experience wonderous explorations.



VICKI CARPER BARTOLINI, professor of education, emeritus and a former chair of the Wheaton College (Massachusetts) Education Department, received the Boston Association for Education of Young Children



Award for STEM.

