

Young Architects at Play

STEM Activities for Young Children

Ann Gadzikowski

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Ann Gadzikowski

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To the many talented and caring teachers and staff membe s
at Preschool of the Arts in Madison, Wisconsin

Contents

Acknowledgments

The winter conference of the North American Reggio Emilia Alliance took place in Madison, Wisconsin in March 2019. My job as a conference volunteer and chair of the local Wonder of Learning exhibit was to drive the featured speakers from place to place. These honored visitors included Marina Castagnetti, an talian author and educator who worked with Loris Malaguzzi in creating the acclaimed preschools and infant-toddler centers of Reggio Emilia; Nunzia Franzese, a rising pedagogista in Reggio Emilia; and Jane McCall, their expert interpreter.

On their one free afternoon in Madison, I asked where I might take them. They said they wanted to see the work of the Wisconsin-born architect Frank Lloyd Wright. So we spent a lovely afternoon visiting landmark Wright buildings, including the First Unitarian Society Meeting House, with its striking geometric windows and vaulted roof.

As we visited these beautiful buildings and talked about our work with children, I was impressed by the many similarities between designing a building and educating a child—two important endeavors that require an understanding of both art and science. The experience deepened my interest in exploring the synchronicities between architecture and early childhood education. I'm grateful to Marina, Nunzia, and Jane for sharing that reflect ve afternoon with me.

I'm also grateful to the children, families, teachers, and staff members of Preschool of the Arts in Madison for deepening my knowledge and experience of Reggio-inspired practices. In particular, this book's emphasis on the use of provocations in inspiring children's curiosity is largely informed by my experience at Preschool of the Arts.

I also thank the children, families, teachers, and staff members t School for Little Children in Evanston, Illinois. Many of the activities in this book were developed and tested in the science, technology, engineering, and math (STEM) enrichment classes I teach there with three- and four-year-olds.

I've always enjoyed block play—first as a child and l ter as a teacher. My work at Northwestern University's Center for Talent Development (CTD) sparked an even deeper interest in the field of architecture and its relevance to early childhood curriculum. I'm grateful to my CTD colleagues Susan Corwith, Beth Dirkes, and Leslie Morrison for their support, encouragement, and collaboration in developing and piloting architecture courses for young children, such as Blocks and Blueprints and LEGO Metropolis.

Many thanks to the wonderful people at Redleaf Press, who continue to champion my work and my books. It's such an honor to be able to call myself a Redleaf author. I'm grateful to Meredith Burks, Heidi Hogg, and Melissa York for their roles in creating this book. I'm especially thankful for the opportunity to work with the amazing Angela Wiechmann on the editing process.

As always, I'm grateful for the love and encouragement of my friends and family. Thank you for helping me lug my bags and boxes of blocks from place to place, and thank you for listening to my dreams.

Prólogo / Foreword

Jorge Raedó, director, Osa Menor Arts Education for Children and Youth

Bogotá, 20 de febrero de 2020

El libro de Ann es agradable, sencillo y útil. Está escrito con sus años de experiencia como profesora de jardín de infancia, tras muchas horas de observación, experimentación y estudio de la realidad infantil.

Ann ha probado diversos materiales y procesos inspirados en la arquitectura y el diseño: volúmenes geométricos, palos, bloques y todo aquello que nos permite levantar estructuras, construir ambientes, esbozar mundos urbanos con calles, casas, parques. . . maquetas y escenografías ue permiten al niño tejer narraciones simbólicas donde puede construir sus deseos, voluntades, temores. . . juegos simbólicos para tejer la red social donde el niño, desde que nace, es.

Cuando digo que hay proyectos que abordan la infancia, la arquitectura* y la educación hablo de una extensa gama de profesionales que trabajan desde diferentes enfoques con diversos objetivos.

El mapa de los proyectos que aúnan infancia, arquitectura y educación podría ser así:

- *Aprendizaje de la arquitectura como un lenguaje del arte.* Igual que los niños aprenden música, pintura, teatro. . . aprenden arquitectura. Cursos y talleres que introducen a los pequeños el ABC de la disciplina: estructura,

*Cuando digo "Arquitectura" incluyo Diseño, Urbanismo, Paisaje.

Bogota, February 20, 2020

Ann's book *Young Architects at Play* is pleasant, simple, and useful. Her writing reflects her xperience as a teacher of young children—her many hours of observation of children's play, her experimentation as a teacher, and her study of children's reality.

Ann has tested various materials and processes inspired by architecture and design: geometric volumes, sticks, blocks, and everything that allows children to raise up structures, build environments, and sketch out urban worlds with streets, houses, parks—models and scenographies that allow children to weave symbolic narratives where they can build their desires, wills, and fears . . . symbolic games for weaving the social network where the child is from birth.

When I say that there are projects that address childhood, architecture* and education, I speak of a wide range of professionals who work from different approaches with different objectives.

The map of the projects that combine childhood, architecture, and education could be like this:

- *Learning architecture as a language of art.* Just like children learn music, painting, and theater, they learn architecture. Courses and workshops introduce children to the ABCs of the

*When I say "architecture," I include design, urban planning, and landscape.

escala, proporción, materiales, luz y sombra, colores, programa, contexto histórico y urbano, sostenibilidad. . .

- *Procesos de diseño participativo con protagonistas infantiles en la transformación de su mundo.* ¿Cómo? Con proyectos donde los niños, con ayuda de sus maestros, profesionales del diseño, padres y comunidad estudian un problema y lo solucionan con el diseño y construcción. Por ejemplo, la transformación del patio escolar.
- *Procesos de regeneración urbana: aquellos proyectos que quieren mejorar el espacio urbano donde vive la infancia.* Por ejemplo, mejora de parques, patios de recreo, y barrios en mal estado fís co y social, y reformas de edificios puntuales como colegios o bibliotecas que ayudan a transformar un sector de la ciudad.
- *Material didáctico y lúdico desde la arquitectura y el diseño.* Los más famosos para centros educativos son los de Froebel, Montessori y Reggio Emilia. Hay decenas de buenos juegos de origen lúdico como los creados por los artistas de las vanguardias artísticas del siglo XX (Ladislav Sutnar, Joaquín Torres-García, Alma Siedhoff Buscher. . .) o las piezas de LEGO o Kapla.
- *Infraestructura educativa.* Los edificios, con los espacios interiores y exteriores que configu an, son una herramienta más para el aprendizaje de la infancia. Toda escuela infantil o colegio (el guante). . . tiene que diseñarse a partir de un proyecto

discipline: structure, scale, proportion, materials, light and shadow, colors, program, historical and urban context, sustainability, and so on.

- *Participatory design processes with children protagonists in the transformation of their world.* How? With projects where children, with the help of their teachers, design professionals, parents, and community study a problem and solve it with design and construction—for example, the transformation of the schoolyard.
- *Urban regeneration processes: projects that improve the urban space where children live.* For example, improvement of parks, playgrounds, and neighborhoods in poor physical and social condition, and updates to specific buildings, such as schools or libraries that help transform a sector of the city.
- *Educational and playful material from architecture and design.* The most famous for educational centers are those by Froebel, Montessori, and Reggio Emilia. There are dozens of good toys designed to be playful, such as those created by avant-garde artists of the twentieth century (for example, Ladislav Sutnar, Joaquín Torres-García, Alma Siedhoff- uscher) or the pieces of LEGO or Kapla.
- *Educational infrastructure.* The buildings, with the indoor and outdoor spaces they configu e, are another tool for childhood learning. Every child care program or preschool (the glove) has to be designed from a clear

pedagógico claro (la mano). Hay buenos ejemplos en el mundo, por ejemplo, las escuelas infantiles de la "estrategia" Reggio Emilia, y los nuevos colegios de Finlandia diseñados desde el principio por los arquitectos y el equipo educativo del centro.

- *Formación continua del profesorado.* Cursos, talleres, publicaciones. . . sobre el potencial educador del espacio, cómo usar un espacio determinado para cumplir con éxito el objetivo pedagógico, el uso de la arquitectura como lenguaje artístico y forma de expresión del niño, los procesos de diseño participativo. . . El profesor es clave en la educación, como el agricultor es clave en el campo.

Ann habla en su libro de experiencias incluídas en este mapa. Ella habla de varios tipos de materiales didácticos en madera dándonos consejos para su uso. También explica el buen uso del espacio para motivar y ordenar la acción del niño, de procesos de diseño participativo desarrollados en varios días, de construcción y destrucción de mundos como forma de expresión. . . es decir, como forma de construcción del mundo personal del niño y del grupo social al que pertenece. Una buena escuela infantil ayuda a mejorar la comunidad que la acoge, como demostró María Montessori hace décadas. Finalmente, el propio libro de Ann es material de la formación continua del profesorado.

La niña explora su entorno inmediato: sillas, cojines, lápices de colores, hojas en blanco, luces y sombras que entran por las

pedagogical project (the hand). There are good examples in the world, for example, the children's schools of the Reggio Emilia "approach" and the new schools in Finland designed from the beginning by the architects and the educational team of the center.

- *Continuous teacher training.* This includes courses, workshops, and publications on the educational potential of space, how to use a specific space to successfully achieve the pedagogical objective, the use of architecture as an artistic language and a child's way of expression, participatory design processes, and so on. The teacher is key in education, just as the farmer is key in agriculture.

Ann speaks in her book of experiences included in this map. She talks about various types of wooden educational materials, giving us tips for using them. She also explains the good use of space to motivate and order the child's action, participatory design processes developed over several days, construction and destruction of worlds as a way of expression, that is, as a way of building the personal worlds of the children and the social groups to which they belong. A good early childhood school helps improve the community that hosts it, as Maria Montessori demonstrated decades ago. Finally, Ann's book is material for continuous teacher training.

The child explores her immediate surroundings: chairs, cushions, colored pencils, blank sheets, lights and shadows that enter through the windows, stones, branches, fl wers, outside air, sand, water, heat and

ventanas, piedras, ramas, flo es, aire exterior, arena, agua, calor y frío. . . observa, toca y huele, capta las formas con sus dedos, las agrupa, relaciona con líneas, construye un mapa, topografía de ormas que activa su imaginación. Surgen historias, personajes, relaciones, intercambios y choques de deseos, confl ctos que ocasionan resoluciones, cambios de formas y evolución de la topografía y las his orias imaginadas. Otros niños se unen al juego y se multiplican las capas de significado.

La niña crece, se hace profesora en una escuela de primera infancia y juega, investiga, estudia, invita a niñas y niños a jugar y explorar el mundo con ella. . . invita a otros adultos a intercambiar conocimientos, a probar esto y aquello, qué funciona mejor, qué nos divierte más. El espacio cambia con nosotros, nosotros cambiamos con el espacio.

cold, and so on. She observes, touches and smells, captures the shapes with her fin ers, groups them, relates lines, builds a map, a topography of forms that activates her imagination. Stories, characters, relationships, exchanges, and clashes of desires arise, confl cts that cause resolutions, changes of forms, and the evolution of topography and imagined stories. Other children join the game and multiply the layers of meaning.

The child grows up, becomes an early childhood teacher, and plays, researches, studies, invites the children to play and explore the world with her. She invites other adults to exchange knowledge, to try this and that, what works best, what amuses us. Space changes with us as we change with space.

INTRODUCTION

Why Architecture?

Preschool teacher Amanda and her coteacher Kelly lead their class of three-year-olds onto the playground. It's a mild spring day, and the smell of freshly mown grass fills the air. The children scatter in all directions. Some start digging with plastic shovels in the sandbox, and others hop on trikes and begin riding along the bike path.

Amanda and Kelly position themselves on the playground so they can see and supervise all the children. Amanda notices one child, Lucy, crouching next to the bike shed. Amanda wonders what Lucy might be doing. Amanda moves toward the bike shed and keeps a close, curious eye on Lucy.

Amanda observes Lucy first kneeling, then sitting on the ground, digging in a patch of dirt with a stick. Intrigued, Amanda wonders, "Why has this child chosen to play in this patch of dirt? If she wants to dig, why doesn't she dig in the sandbox?" But rather than interrupt Lucy's play, Amanda decides to observe Lucy to see how her play develops.

Amanda notices that Lucy doesn't seem upset or lonely. In fact, the expression on Lucy's face is happy and relaxed. She seems focused. She also collects additional sticks and other small objects that happen to be nearby: a few large leaves, a smooth stone, a handful of flat wood chips. Lucy carefully arranges these small items on the patch of dirt. Next she takes a handful of twigs and pushes them into the soft dirt. She then props a layer of flat leaves across the top of the sticks.

Amanda wonders what Lucy might be building. But again, she does not want to interrupt. Instead, she takes a few steps closer to get a better view of the work.

As Amanda nears, Lucy take a small round stone and places it at the front of her structure. She then looks up at her teacher and smiles. Lucy points to the stone.

"She lives here," she says.

"Oh, are you making a house?" asks Amanda.

Lucy's face lights up. "Yes!" she says. "It's a house. I'm building it."

In this scenario the teacher, Amanda, observes a child at play and wonders about the meaning behind it. Like many reflect ve teachers, Amanda is curious about the choices children make during play. In this case she wonders why a child would choose to dig in the dirt and build a structure using stray objects found on the ground, especially when a sandbox and a variety of digging toys are available nearby.

After reading this scenario, you may have been curious too. Perhaps you have your own ideas about the reasons behind this child's choices. Maybe you

Building a house out of blocks is almost a universal play experience.

can recall your own experiences playing outdoors as a child. Do you remember the allure of building something out of sticks and other natural materials you picked up from the ground?

Children seem to universally enjoy building, whether with natural objects, blocks, or other materials. Human nature and the drive to create feed the desire to build.

Children also often create narratives around the structures they build. In this scenario Lucy is not only building a structure but creating a pretend story in her head. She uses a stone to represent the character who lives in this little building.

This is a single, ordinary moment in the relationship between a teacher and a child—seemingly nothing more than a brief exchange about a pile of sticks and leaves. Yet it contains many elements of best practices in early childhood education: an observant and supportive teacher, a curious child engaged in play, a construction project utilizing open-ended materials or "loose parts," and the narration of a story that gives meaning to the child's play.

What Is Architecture?

As an early childhood educator, I am fascinated by children's construction play. I have a deep appreciation for how it allows children to develop cognitive skills, express creativity, and add complex layers of story and meaning.

In my work with children and teachers, I've found that architecture is the bridge that connects these ideas. Architecture is the art, science, and process of planning, designing, and constructing buildings. The word *architecture* can refer to this process as well as the buildings that result from it. In this book I will focus on *architecture* as a creative process.

We often associate architecture with famous architects and complex buildings and structures. But architecture gives us vocabulary to talk about the buildings and structures all around us. You likely have a roof over your head right now as you read this page of words. Understanding architecture helps us better notice what architects call "the built environment": houses, apartment buildings, and other structures as well as roads and bridges.

As you will discover in this book, architecture also gives us examples, both real and imagined, that inspire and provoke exciting construction projects in early childhood classrooms. As a teacher, I believe thinking and learning about architecture has significantly enhanced my ability to support children's construction play and deepen their learning experiences.

Architecture and Children

The child who pokes sticks in the dirt and builds a home for her rock is an architect. Every child who constructs a house out of sticks or stones or blocks or LEGO is an architect. Architecture is demonstrated every day in children's play across the globe.

So why don't we see the topic of architecture included in early childhood education? Why is it almost invisible when it comes to how and what children learn?

We usually only find c urses and curriculum bearing the title of "Architecture" at the college level. And out of the 1.5 million bibliographic records in the Educational Resources Information Center, only *two* records are related to teaching young children about architecture. Both involve projects with school-age children (kindergarten through grade five) (Hollingsworth 1993; Luera and Hong 2003). There are *zero* articles documenting any connection between the topic of architecture and children five and younger.

It seems that architecture is not intended for children. However, young children usually already have an intuitive sense of architecture. More simply, they understand that every building has a purpose. They understand that homes are built to provide shelter. Schools are built so we can come together and learn. Stores are built so people can buy food and other things they need. And hospitals are built so we can take care of people who are hurt or ill. Children realize there is a clear sense of purpose in the various buildings and structures in our communities—a sense that form follows function.

Therefore, there are many developmentally appropriate ways that the study of architecture can begin in early childhood. For example, children may look at pictures of different kinds of buildings, visit buildings in their neighborhoods, and talk about why and how we build. In turn these architecture-related activities can inspire children to develop new ideas through block and construction play. Talking and thinking about architectural features, such as doors and windows, can also add complexity and interest to children's construction projects.

Constructivism and Architecture

Constructivism is a theory of cognitive development. It is centered on the idea that children learn through direct physical experience, through play, and through their interactions with their environment. This approach to early

learning, as articulated by theorists Jean Piaget and Lev Vygotsky, emphasizes the importance of children's physical, sensory experiences with the world around them.

No doubt construction play is a true form of constructivist learning. Whether with blocks, toys, or other materials, construction play is at the core of developmentally appropriate practice.

As a constructivist early childhood educator, I believe architecture provides an important connection bridging young children's play to the real-world skills and knowledge they will develop as productive adults. Architecture engages all four STEM content areas: science, technology, engineering, and math.

Construction play and architecture-inspired activities also develop important spatial skills. This is especially true when children represent their ideas using three-dimensional tools (blocks, loose parts, and construction toys) as well as two-dimensional tools (drawing, writing, and mapping).

Construction play is at the core of developmentally appropriate practice.

At the same time, architecture also provides opportunities for creative and artistic expression, language development, and literacy development. Ludwig Mies van der Rohe, the German American regarded as a pioneer of modernist architecture, is credited with asserting that "architecture is a language" (Domus 2016).

This phrase calls to mind the words of Loris Malaguzzi, founder of the renowned infant-toddler centers and preschools of Reggio Emilia, Italy. Malaguzzi explored the concept of "the hundred languages of children." He wrote, "The child has a hundred languages, a hundred thoughts, a hundred ways of thinking, of playing, of speaking. A hundred, always a hundred ways of listening, of marveling, of loving, a hundred joys, for singing, for understanding, a hundred worlds to discover, a hundred worlds to invent, a hundred worlds to dream" (Malaguzzi 1993, 3).

It's highly unlikely that van der Rohe and Malaguzzi ever met, yet their ideas beautifully align. Architecture is indeed a language—one of the hundred children use to express themselves. This language can be artfully expressed even on a small scale, as represented in construction play and architecture explorations in the preschool classroom.

Benefits of Architectural Play

Simply put, architectural play supports children's capacity to learn. Here's how the open-ended and creative play experiences described throughout this book support healthy brain development:

- Construction play is meaningful. When children build freely from their own imagination, creating houses and other structures, they connect their prior knowledge with new inventions and experiences. Making meaningful connections stimulates networks in the brain associated with logical thinking, metacognition, and creativity.
- Construction play is actively engaging. The physical tasks associated with construction play—such as lifting, s acking, and balancing—activate areas of the brain associated with decision-making, executive function, and self-regulation.
- Construction play is iterative. An iterative process is one that involves repetition, experimentation, and exploration. During construction play, towers fall, roofs cave in, and walls tumble. Most children are eager

to try and try again until they find success. The perseverance demonstrated during construction play engages neural networks that are associated with flexible thinking and creativity.

- Construction play is socially interactive. In most early childhood classrooms, construction play takes place in pairs and small groups. Collaboration and conversation promote plasticity in the brain that helps children develop empathy and social skills.
- Construction play is joyful. The block corner is often the loudest area of the classroom—and for good reason. Joy is noisy. The excitement of building with blocks or any material makes children laugh and call out to each other with joy. This sets the stage for a lifetime of health and well-being, as joy is associated with chemicals that are linked to enhanced memory, attention, and motivation, such as dopamine.

Physical, Tangible, and Sensory Construction Play

The value of hands-on construction play has long been embraced by leaders and thinkers, such as Piaget and German educator Friederich Fröebel, who created the first kindergarten in the early nineteenth century. More recently the value of hands-on construction play has been the focus of educators and parents who are concerned about children's screen time—the time they are engaged with tablets, smartphones, laptops, and other electronic devices.

For many children, playing in a virtual world with electronic devices has replaced some of the time they would spend playing in the real world with tangible objects. In particular, many children enjoy virtual construction games and apps, including Toca Builders and Minecraft

Common Sense Media is a nonprofit organization that provides research and recommendations regarding technology and media. It reports that for children ages eight and younger, one-third of all screen time is on mobile devices, and between 2011 and 2017 the amount of time children spent on mobile devices tripled (Common Sense Media 2017).

While there may be many benefits to learning how to navigate digital tools, concerns about screen time have been expressed at every level of education. Constructivist educators and advocates for developmentally appropriate practice recognize that hands-on construction play—with real, tangible tools—offers cognitive, physical, and social benefits that can't be gained from a screen.

Debbie Sterling is a Stanford-trained engineer and inventor of GoldiBlox, a media company focusing on the principles of STEM. She advocates for hands-on construction play in early childhood, as it establishes a foundation of essential spatial reasoning skills (Sterling 2013).

A similar observation was made at the college level, illustrating how construction play builds real-world skills. Ron Kasprisin, architecture professor and author of *Play in Creative Problem-Solving for Planners and Architects*, advocates using tangible tools, such as cardboard, foam, and clay, as part of the design process for his architecture and urban-planning students. He writes, "My recent experiences (over the past five years or more) with undergraduate and graduate students in planning and design who have not used any methodology or tool except those related to the computer (digital technologies) have strengthened my resolve to bring back the other half, the sensual half of the creative process" (Kasprisin 2016, 206). At every level of schooling, from early childhood to college, educators and researchers are noting the importance of balancing digital learning with tangible learning.

The Theme of Home

In early childhood classrooms we may not use the word *architecture*, but we often use the word *home*. Children intuitively understand the purpose and meaning of a home. They know it is where you eat, sleep, rest, go to the bathroom. Important things happen there. A home is a place of belonging, a place for family and friends. Homes can be big or small. They can house a single family or, in the case of a tall apartment building, can house many families.

A home provides shelter, which is an essential human need. Erik Erikson's theory of human development tells us that our first task on this earth is to learn to trust. It's the foundation on which all relationships and meaningful experiences are built. A home—with a literal foundation, a sheltering roof, and a soft place to rest—is a tangible, physical representation of the trust we build from birth. A home holds us and keeps us safe in the same way that children's trusted caregivers—their parents, family members, and teachers—hold them close and protect them.

It makes sense, then, that a house is the structure children most often choose to build with construction materials. Just as children construct their knowledge of the world and build their sense of trust in others, they also build homes and houses with their hands.

A common theme in construction play is building a house.

The unifying theme of this book, then, is the concept of home—the most familiar sheltering structure in children's lives. The concept of home also allows for an unlimited variety of related projects and investigations into other homes: dollhouses, tree houses, doghouses, and so on.

However, when we focus on homes in our construction activities, we must be aware that this topic can be very emotional and intense for some children. When children are at school, they often think of home, and some desperately miss their homes and family. All of us long for the safety and security of our homes.

Also, intentional teachers in inclusive classrooms are aware that some children may be experiencing or have experienced homelessness or housing instability. Others may have experienced traumatic changes in their living conditions. Even an ordinary family move from one house to another can be frightening and confusing for young children. Exploring the idea of home during construction play is one way we can offer children some power and creative autonomy.

Teachers can support and facilitate construction play by "building" on children's interest in homes and houses. Provocations and open-ended questions can spark new ideas about the design and architecture of the homes

children construct. You can also open children's minds to new possibilities by sharing interesting images of homes from architectural websites, magazines, and picture books. (Be sure to check out Recommended Resources at the end of the book.)

The Importance of Deconstruction

When children play with construction materials in a preschool classroom, they often don't use any kind of adhesive to permanently hold the pieces together. Many structures are temporary or fragile.

Therefore, we must discuss *deconstruction* as well as *construction*. While it may be easy to dismiss deconstruction as nothing more than a simple cleanup task, deconstruction creates opportunities for building social skills, exploring emotions, and developing logical and analytical thinking.

The emotional aspect of deconstruction calls to mind the classic British nursery rhyme "Ring a Ring o' Rosie." Its American version, "Ring around the Rosie," usually sounds like this:

Ring around the rosie,
Pocket full of posies,
Ashes, ashes!
We all fall down!

Children delight in saying and acting out the final lin , "We all fall down!" As children tumble to the floo , there is slapstick humor as well as a release—a letting o—that children seem to find ery satisfying.

Similarly, most children delight in the action, the release, of knocking over a block tower or plowing over a sand structure. There is an undeniable sense of power in destroying something. In the block corner, all children are tiny gods and goddesses. When you can build but also destroy, you have complete autonomy over your own domain.

That said, facing the moment of deconstruction can sometimes be heart-breaking, especially when a child or a group worked very hard on a beautiful and elaborate structure. This is why it can be helpful for the teacher (or the child) to take a picture or draw a sketch before deconstructing. That way the children at least have a record of their work.

One of the important rules in my classroom is that the person who builds a structure is the person who gets to knock it down. A child is not allowed

Deconstruction, which includes putting away blocks, is an important part of the learning process.

to knock down someone else's structure without their permission. Children understand the logic of this rule intuitively.

That is, they *understand* it, but they don't always *follow* it. Sometimes a friend knocks over someone else's structure out of anger or an uncontrollable impulse. And of course accidents also happen. Sometimes someone accidently bumps someone else's structure. Whether a structure gets destroyed by accident or intent, appropriate amends must be made. One child can help the other child rebuild. This is how deconstruction becomes a teachable moment for social development.

In addition to the emotional and social elements, deconstruction provides many opportunities for logical and computational learning. At the core of Fröbel's curriculum and philosophy is the concept that a whole is made up of parts. Fröbel's kindergarten guide states, "From a knowledge of the outside, "instinct prompts the desire to know the inside" (Krause-Boelte and Krause, 1881, 28). When children learn first o build and then take apart physical things, they begin to think in logical and analytical ways.

The Architecture of This Book

Throughout this book there is an emphasis on higher-order thinking and critical thinking in STEM. The structure of the chapters, and of the book as a whole, provides a path for scaffolding learning about architecture and related STEM topics.

The book is divided into two parts. In part 1 each chapter focuses on a specific type of material or tool: blocks, natural materials and loose parts, found objects and recycled materials, and wood. In part 2 we'll examine how to facilitate architectural explorations using resources such as picture books, maps, and collaborative projects.

The chapters progress from the most familiar materials and ideas to the most novel materials and challenging ideas. Likewise, the ideas and projects within each chapter are organized on a continuum, beginning with the most open-ended activities and progressing to more structured projects.

As a whole, this organization represents the way young children typically respond to construction materials. They begin with open-ended exploration and then form ideas and intentions about how the materials can be used.

Provocations

For every project in this book, you will find d tails about how to create provocations. *Provocation* is a term frequently used by Reggio Emilia–inspired educators to describe a display or presentation of materials that teachers intentionally arrange to "provoke" or inspire learning. A provocation often involves something children may not have encountered before—a novel item or a new combination of materials. Teachers usually assemble a provocation before the school day begins. That way the provocation will greet the children as they enter the classroom and perhaps spark conversation and excitement during the first art of the day.

For example, a provocation for a block activity might be as simple as a sequence of three unit blocks placed fl t, end to end, in a row. This would perhaps invite a child to continue with the sequence and create a path or road. Another provocation might include an image of a building to inspire construction play. Perhaps a novel mix of construction toys or materials, such as domino tiles or craft st cks, might provoke new ideas for creative building.

This simpl provocation, magnetic tiles and a string of holiday lights, draws children's attention to the transparency of the tiles.

A provocation can be placed in a central location in the classroom, such as on a table or a rug. As children are welcomed to the classroom at the beginning of the day or session, their attention will be drawn to the materials.

That said, a provocation does not always have to be placed in a prominent location. A small provocation can be displayed in an out-of-the-way location in the classroom. It can be a little surprise for the child or children who discover it.

Provocations ease children not only into a specific activity but also into their day. Seeing an array of interesting materials might help children who feel sad or worried when they separate from their caregivers. A provocation gives children something to look forward to and provides a space to begin playing with a friend. Engaging in play at the start of the day or session also helps support children's social development. The open-ended nature of loose parts allows each child to play at their own pace and explore their own interests. Everyone can take part.

A Final Word

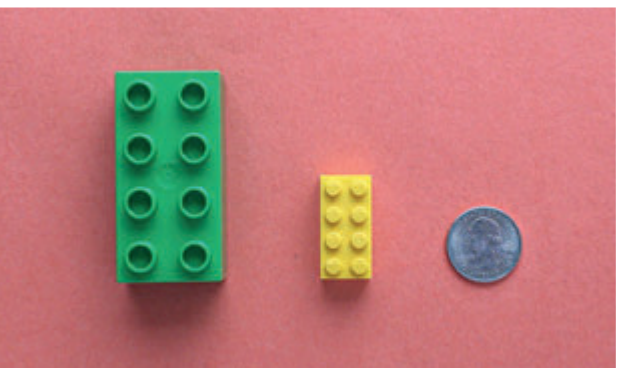
I am an old-school constructivist early childhood educator inspired by Reggio Emilia. I have had the good fortune of working alongside excellent STEM educators at Northwestern University, where I learned how to introduce STEM concepts to young children using developmentally appropriate practices. This book is also informed by the Reggio Emilia–inspired practices at Preschool of the Arts in Madison, Wisconsin.

My hope is that this book will build a bridge between construction play in early childhood classrooms and the real-world experience of architecture in the daily lives of every human being. As I researched for this book, I was often reminded of the lovely British expression "Safe as houses." It means to be quite secure and trustworthy.

I hope this book will become a trusted resource for you and the children you teach.

PART I

Materials



CHAPTER 1

Blocks and Construction Toys

As mentioned in the introduction, construction play is a demonstration of constructivist learning. Piaget and Vygotsky teach us that children construct knowledge through their direct experience with the environment and with other people. Constructivism relates to all kinds of active play, but it is most beautifully relevant to block play. When children build with blocks, they literally construct their knowledge of shape, size, weight, scale, balance, symmetry, gravity, and more.

In terms of learning, block play develops many of the "big ideas" of early math as defined y the Erikson Institute Early Math Collaborative: shape, spatial relationships, patterns, and measurement (Brownell et al. 2014). Block play also demonstrates all five of the characteristics associated with healthy brain development described in the research summary *Neuroscience and Learning through Play: A Review of the Evidence*, published by the LEGO Foundation (Liu et al. 2017).

In addition, building with blocks is creative expression, a demonstration and practice of architectural design concepts. Frank Lloyd Wright famously noted the relationship between his childhood experiences with blocks and his exceptional career as an architect: "The smooth cardboard triangles and maple-wood blocks were most important. All are in my fin ers to this day. . . . I soon became susceptible to constructive pattern evolving in everything I saw. I learned to 'see' this way and when I did, I did not care to draw casual incidentals to Nature. I wanted to design" (Turner 2011).

Let's take a closer look at how and why block play is an integral part of early childhood education.

The Unit Block

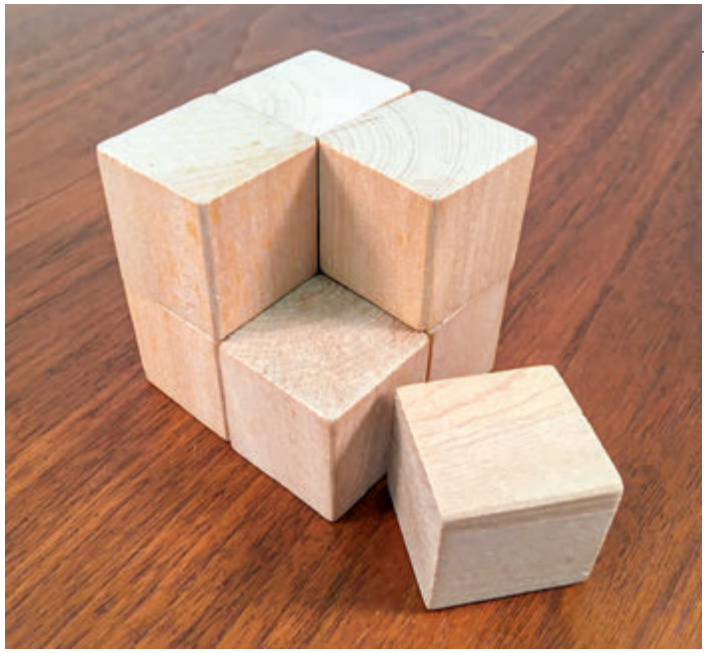
Just as a living organism is made of individual cells, a preschooler's complex block structure is made of individual blocks. And in early childhood classrooms, the cell of constructivist play is the basic brick, also known as the unit block. It has a standardized shape and size consistent among toy and school supply products.

The standa d unit block is 5.5 inches long, 2.75 inches wide, and 1.375 inches thick.

The idea that children will benefit f om building with uniform blocks stems back to Fröbel, who designed a numbered series of classroom toys called "Gifts " When examined in order, each Gift is mo e complex than the previous one.

For example, Gift 1 is a simple all, a sphere. Gift 2 is a s t of three objects with different shapes: a sphere, a cube, and a cylinder. Gift 3 is a s t of eight cube blocks, which can be assembled into a larger cube as a tangible lesson in how the whole is the sum of its parts. Gift 4 is a s t of eight rectangular prism blocks. Many popular construction toys, such as LEGO, can trace their heritage back to Gift 4

Inspired by Fröbel's Gifts, Amer can educator Caroline Pratt designed unit blocks in the early twentieth century. Pratt as both a preschool teacher and a woodworker. She tested many different block proportions and types of wood until she came up with what she believed was the perfect design for construction play. At 5.5 inches long, 2.75 inches wide, and 1.375 inches thick, the unit block has a mathematically beautiful ratio of 1:2:4.



The thi d Fröbel Gift is a set f eight cube blocks.

Few play materials provide more benefit han wooden blocks. So even if your set of unit blocks is battered and worn, it's still one of the most valuable treasures in your classroom. In *The Design of Childhood: How the Material World Shapes Independent Kids*, Alexandra Lange remarks that unit blocks "always seem to be used most quickly, forcing children to assemble more idiosyncratic pieces—the squares, the right triangles—back into satisfying bricks, teaching basic principles of geometry, by the by, the same way Froebel's cubes-in-a-cube did" (Lange 2018, 31).

The Role of the Brick in Architecture

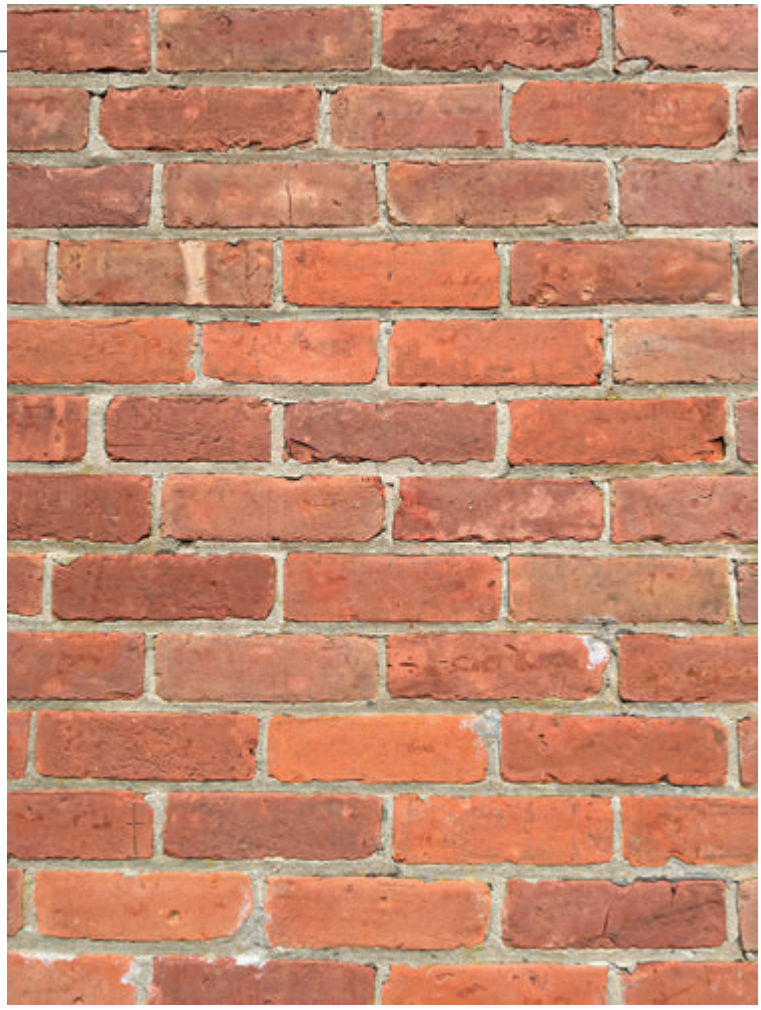
Building with unit blocks is not just a whimsical or abstract activity for children. Rather, it's a direct connection to actual construction in the real world. Just as unit blocks are essential to block play, basic bricks are essential to architecture. Take a quick glance around your community and you'll see how ubiquitous bricks are in the design and construction of buildings.

Masonry is a type of construction that uses stone or concrete bricks, blocks, and tiles. Bricks have a standard size and shape in masonry construction. Like unit blocks, they are rectangular prisms. Mortar, a binding adhesive, is used to hold the bricks together. Bricks are often made of clay, not wood.

The term *brickwork* is used to describe the patterns and processes used to lay the brick.

Why are bricks so essential? As a teacher, I often ask children, "Would you rather build a house out of unit blocks or cubes? Why?" So I now ask you, my reader, a similar question: "Why is a rectangular prism better for building than a square cube?"

You might begin by commenting that a rectangular prism has elongated planes, or sides. In contrast a cube has square planes with less surface area. This is key. The elongated planes provide more surface to spread mortar. And due to its longer length, a rectangular prism also lends itself better to an alternating pattern than does a cube. Staggering the bricks in their placement creates a much stronger wall than placing them in direct alignment.



The oncept of the brick, a rectangular prism, is important in both architecture and block play.

Other Types of Blocks

Wooden unit blocks are practically perfect for any kind of preschool block play. However, there are certainly other options and block systems to inspire architectural play.

Wooden plank blocks, such as KEVA or KAPLA blocks, share many features with unit blocks. Each plank is a standard and uniform size and weight, though smaller and lighter than unit blocks. Plank blocks can be used on either the floor or a able. Because they are smaller than unit blocks, plank blocks require greater dexterity to manipulate and are better suited for older preschoolers and kindergarteners.

Plank blocks are smaller and lighter than unit blocks.

Cube blocks are less common than rectangular prism blocks. The different shape offers varied opportunities for building. A set of simple wooden cube blocks is reminiscent of the original Fröbel Gifts f om the nineteenth century. And yet many children today are drawn to cube blocks, either wooden or foam, because they are inspired by digital games such as Minecraft. C bes are the literal building blocks for structures and even characters in these games.

Magnetic tiles and blocks are also popular construction toys. Some brands include Magna-Tiles, PicassoTiles, and Tegu Blocks. Interestingly, building with magnetic toys is both very easy and very difficult for children. It's easy because the magnets snap the blocks together, keeping them connected without having to worry about balance and symmetry. On the other hand, if the magnets aren't properly aligned—say, if a positive pole meets another positive pole—the blocks will snap apart or shift heir position.

If you have magnetic building toys in your learning environment, it's important to talk with children about how magnets work. This helps scaffold their understanding so they can learn how to take advantage of the power of the magnets.

For example, if something unexpected or frustrating happens to a child building with magnetic construction toys, turn it into a teachable moment. Begin by asking open-ended questions to gauge what the child already understands about magnets. You might say, "I see the roof of your house snapped apart and fell down. I wonder why that happened. What do you think?"

Perhaps the child will say the word *magnet* and show some understanding of how magnets work. In that case help her explore, through trial and error, how turning the block around will make a stronger bond.

Or perhaps the child has no experience with, or understanding of, magnets. Then it might be helpful to use a pair of plain horseshoe or bar magnets, with the poles labeled and visible, to show the child how magnets can attract and repel each other. Once a basic concept is in place, you can apply it to how the blocks attract and repel.

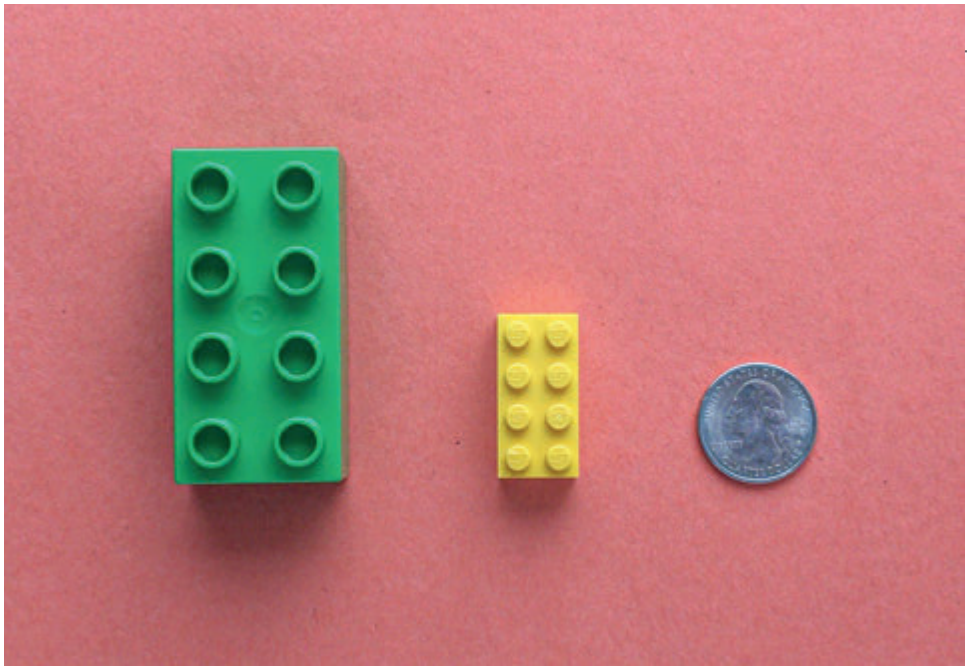
LEGO Blocks

LEGO is a very popular block system. Invented in 1932 by Danish toymaker Ole Kirk Cristiansen, LEGO blocks are colorful, come in many sizes and shapes, and are relatively inexpensive.

Also popular is Duplo, LEGO's chubby cousin. Duplo blocks are recommended for children under age three and for children new to LEGO construc-

tion. Because Duplo blocks are larger than LEGO blocks, they are easier to manipulate with little hands, and they don't pose choking hazards.

Both LEGO and Duplo blocks offer a different experience than wooden blocks. Wooden blocks rest on each other, using only the force of gravity, while LEGO blocks have an interlocking design that firmly sn ps together. It's important to stress, however, that due to this interlocking system, LEGO blocks can't provide the same level of challenge and creativity as wooden unit blocks. Children develop fine-m tor and cognitive skills as they learn to balance and align wooden unit blocks in strong and symmetrical patterns.



A Duplo brick, shown here in green, is much larger and easier to manipulate than a LEGO brick, shown here in yellow.

As supplemental construction toys, though, LEGO blocks inspire nearly endless creativity for building, design, and construction. Because of their versatility, they are well regarded as a learning and modeling tool among many professional architects.

The LEGO House—a children's museum and play space in Billund, Denmark—features an interactive exhibit called "6 Bricks Factory." The exhibit demonstrates how even a small number of classic LEGO bricks can be arranged in many creative ways. In fact, mathematician Søren Eilers has determined that six LEGO bricks can be arranged in 915,103,765 combinations (Higgins 2017).

A Word about Themed LEGO Sets

As a Reggio-inspired educator who values child-centered learning, I feel compelled to clarify that I recommend only Classic LEGO sets as a creative tool for construction play. Classic LEGO sets contain a variety of basic block shapes for open-ended play so children are free to build structures from their own imagination. These sets align with the emergent curriculum process, which allows children to develop their own ideas and their own path of learning.

I usually do not, however, recommend themed LEGO sets—those that contain step-by-step instructions and are designed to build specific finishe products. This includes LEGO-brand themes (such as LEGO City and LEGO Friends) as well as media promotion themes (such as Star Wars and Marvel). The p edesigned sets limit imagination and building opportunities. In particular, some themed sets promote mass-media franchises, movies, shows, and digital games that depict violence and portray gender and cultural stereotypes.

Blocks and Deconstruction

Nearly every block construction activity turns into a deconstruction activity at some point—whether by intent or accident. As we discussed in the introduction, deconstruction provides many opportunities for emotional and social development as well as logical and analytical thinking.

Fröbel's Gift 3, he eight cubes, demonstrates how deconstructing a block structure is a form of early mathematical learning. The eight cubes stack into a larger cube and are stored in a box shaped like a cube. Because the larger cube is made of parts, it can be constructed and deconstructed.

Fröbel's blocks suggest a parallel between deconstruction in block play and decomposition in mathematics. To decompose numbers means to break them down into their subparts. Number decomposition is typically taught in kindergarten. So while preschool children might not be ready to learn about numbers decomposition, hands-on experiences with blocks can provide foundations for computational thinking.

The Block Corner

To be licensed and accredited, child care and preschool classrooms are often required to provide space for block play. There are many practical considerations when choosing where and how to set up your space.

The "block corner" is a common feature in many early educational environments. A corner of the classroom is quite often the logical choice, as it will keep the block area away from the regular fl w of traffic. A carpet or rug with a smooth low pile will help dampen the loud sounds of the blocks when they fall to the floo .

A classroom set of unit blocks usually includes fi y to one hundred blocks. Store them on open shelves that are labeled with a tracing or image of each shape. This gives children easy access to select specific sizes and shapes and will also help during cleanup time. It will become yet another deconstruction learning opportunity as the children practice observing and sorting three-dimensional shapes.

The block orner can be one of the most beautiful and interesting areas of a classroom.

Project 1

BUILD A HOME FOR A FAVORITE TOY

The design of a home is influenced by the needs and movements of the people—or toys—living there. Building a home for a favorite toy is a wonderful introduction to some of the core concepts of architecture. A child who may not ordinarily be interested in playing with blocks can likely be persuaded to create a cozy home for a little toy. And a child who already builds with blocks may enjoy a new, purposeful challenge.

Materials

The materials for this project are simple: unit blocks and small people or animal toys. Preferably, the toy figu es should be no taller than 5.5 inches, the length of a unit block.

Provocations and Invitations

Place a bin of small toy figu es in the block corner. One-on-one or in a small group, invite children to select a favorite toy from the bin. (You could also invite the children to bring a toy from home.) Ask the children, "Where does this little friend live? Does it need a home?" At the beginning of playtime, invite the children to use the unit blocks to build a home for the toy.

Considerations

Beyond the initial invitation, children will probably not need much assistance to begin building a home for their toy. Teachers may need to facilitate the sharing and distribution of blocks.

Big Ideas and Open-Ended Questions

As children build, ask open-ended questions that draw their attention to the characteristics of a home or house:

"What kind of home do you think this toy needs?"

"How big should it be? How do you know?"

"How will you build a home for the toy?"

"What do you think you need to do firs ?"

"What do you think you need to do next?"

"Which blocks will you use?"

A home built for a toy may or may not have a roof. Children may prefer to leave the roof open so they can still see and play with the toys inside.

"What shapes do you need?"

"How will you make the house strong and safe?"

"What are the parts of your house?"

"Do you need walls? What about a roof? Do you need doors? What about windows?"

"How will your toy go in and out of this house?"

"What will your toy do in its house?"

"Is this a house where friends can come and visit? Where will they stay?"

Next Steps

To extend learning and play, invite children to have their toys visit each other's houses. Children may also enjoy making roads or pathways between houses. Blocks or paper could be used to make roads.

Project 2

ROADS AND BRIDGES

The roads and bridges that connect our homes are an important part of what architects and engineers call the "built environment." Constructing roads and bridges with blocks challenges children to use spatial reasoning in new and different ways. When children connect their structures, they collaborate and gain experience using language and social skills.

Materials

In addition to unit blocks, you will need toy cars and trucks, preferably one to two inches wide. To represent water, you will need strips of blue construction paper, about two to three inches wide.

Provocations and Invitations

Adding a basket of toy vehicles to the block area will often lead to the spontaneous building of roads and bridges. You can also wait until children have built several structures or houses, then introduce the vehicles as a method of transportation between the various buildings. As children roll the toys across the floo , ask, "I see that car is moving fast. Does it need a road?" If a vehicle encounters an obstacle in its path, suggest building a bridge to travel over the obstacle. Strips of blue paper can be used to represent rivers, and children can be invited to build bridges over the rivers. The blue paper can be laid on the floor t the start of the play period or added later, after the construction play has begun.

Considerations

Children will need a large, open area on the floor o build roads and bridges. You may need to move some furniture temporarily to make room.

When children work on connecting a bridge to a road, they may notice that they need some kind of ramp to provide their vehicle with a smooth transition from road to bridge. Unit block sets usually include several different kinds of triangular prisms that can be used as ramps. Let the children figu e out which block will work best as a ramp, but be ready to help support their experimentation and discovery. You might ask, "I see your car needs a way to drive onto the bridge. What kind of block could you add in that spot?"

Big Ideas and Open-Ended Questions

As children build roads and bridges, ask questions that draw their attention to the design features of these types of structures:

"What kind of road do you need? Smooth or bumpy? Straight or curved?"

"How will you build your road?"

"What kinds of blocks do you need to make your road?"

"How will you begin?"

"Here's a river. What can you do to make your road go over the river?"

"Do you need a bridge? Have you ever gone over a bridge? What was that like?"

"What are the parts of a bridge?"

"What holds the bridge up?"

"How tall do you want your bridge to be?"

"How can you make your bridge very strong?"

"What can you do to make sure your bridge is fl t and straight?"

Next Steps

The process of building roads and bridges with blocks provides natural opportunities to talk with children about measurement. Ask questions that focus children's attention on the importance of measuring.

For example, as children build a bridge across a paper river, ask, "How long will you make your bridge?" Children can measure their bridge by how many blocks they used ("This bridge is two blocks long"), or you could show them how to use a ruler and more standard units of measurement.

Children will learn through play that a long bridge requires additional supports. Again, ask questions that draw their attention to these design features: "I see this bridge has some extra blocks holding up the middle. How did you know these blocks were important?"

Project 3

TOWERS AND APARTMENT BUILDINGS

Not all children live in traditional single-family homes. Children who live in multifamily homes and apartment buildings will enjoy creating structures that mirror their own familiar environment. Children who live in traditional single-family houses will benefit f om learning about different kinds of homes.

Materials

You will need unit blocks, small people and animal figu es, and wooden or pressboard planks. If you find hat your collection of classroom blocks is not large enough for creating a variety of interesting and complex structures, try adding a few fl t wooden or pressboard planks. Children can use these fl t pieces for floors and oundations. I recommend rectangular pieces one to two feet in width and length and about one inch thick. Make sure the edges are smooth and will not cause scrapes or splinters.

Provocations and Invitations

Illustrations and photographs of different kinds of homes can be used as provocations that inspire children to build a wide variety of creative structures. You may want to provide photos of multifamily homes and apartment buildings from your community. I also recommend the following picture books:

Home by Carson Ellis (2015)

If You Lived Here by Giles Laroche (2011)

Windows by Julia Denos (2017)

Houses and Homes by Ann Morris (1995)

You Belong Here by M. H. Clark (2016)

Considerations

Unit blocks rarely cause injuries, but whenever children build tall towers out of blocks, make sure there's enough space around the structures for a safe "fall zone." If children build them too close together, blocks might fall on children or knock over other structures in progress.

Many children enjoy the challenge of building tall towers.

If you are using very large, heavy blocks, such as hollow wooden blocks, help children choose a building site that is a safe distance from where other children are playing on the floo . Very large blocks can also be used outdoors.

Big Ideas and Open-Ended Questions

Building larger and taller structures inspires children to solve more complex engineering problems. Constructing a tall tower of blocks requires a strong and steady base. The blocks must be balanced and aligned carefully to keep the tower from toppling over. Mistakes are opportunities for learning.

Ask questions and make observations that draw children's attention to the architectural features of towers and other large buildings:

"How will you make your building taller?"

"Which blocks work well for tall towers? Why?"

"How is building a tall tower different from building a short, little house?"

"Who lives in this building?"

"How will the people get from floor o floo ?"

"I see that you put a foundation of large fl t blocks at the base of your structure. Why did you choose to build it that way?"

"I noticed that your tower fell over and now you're building it again. Are you doing it the same way, or are you doing something new?"

Next Steps

Young children often become captivated by the idea of building a tower that reaches very high, perhaps even all the way to the ceiling. A wonderful example of this fascination is documented in the film *Thinking Big: Extending Emergent Curriculum Projects* (Felstiner, Pelo, and Carter 1999).

One of the great ideas demonstrated by the teachers in the film is i viting the children to build a tower on the surface of a mirror. A shatterproof acrylic mirror was placed fl t on the floo . The children were invited to build on top of it with blocks. The children were amazed by the way the reflect on seemed to depict the tower "growing down" as they built upward. Adding mirrors to construction play often adds surprising new perspectives and ideas.

Help young children construct their knowledge of the world

When we see children's construction play through the lens of architecture, we are able to support and extend learning on all four STEM subjects: science, technology, engineering, and math. *Young Architects at Play* is a guide for both teachers and parents and includes more than 20 projects involving traditional classroom materials like unit blocks as well as natural materials, found objects, cardboard, and authentic woodworking materials.

Throughout the book, Ann Gadzikowski makes meaningful connections between STEM learning and the power of stories, both from the children's own narratives and a rich diversity of children's literature.

"In *Young Architects at Play* Ann Gadzikowski skillfully blends research, practical insights and a deep knowledge of facilitation to provide educators and caregivers a rich tapestry of how to lead children through learning as they play. Working across digital and physical worlds, easing planning and encouraging observation while reminding us how fun learning is, this manual is a testament to the marriage of art and science that is early childhood learning! Welcome to your journey of playing with your student or child!"

— Tarun Varma, Experience Implementation Specialist, LEGO Foundation

"*Young Architects at Play* is a good help for preschool teachers both in theory and practice to embrace architecture, building, and construction in a playful and pedagogic way."

— Suzanne de Laval, co-director, Architecture & Children Work Programme UIA (International Union of Architects)

"As we think about children being the designers and builders of their play, *Young Architects at Play* acts as a blueprint for how to support children's construction play and digs deeply into why construction play supports learning."

— Elizabeth Tertell, MEd CAS, senior instructor, Erikson Institute

Ann Gadzikowski is the director of early learning for Encyclopedia Britannica and the author of curriculum books, teaching guides, classroom readers, and numerous publications for parents of young children.

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